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THE PROMISE OF TECHNOLOGY[1]

By Dr. FRANK B. JEWETT

VICE-PRESIDENT OF THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY

Prognostication, and especially long-range prognostication of technological advances, particularly those related to new sectors, is an extremely hazardous performance even in normal times. When one attempts to make prognostications for a postwar peacetime period, when one is in the midst of the turmoil of war, it is a hazardous undertaking raised to the nth power. The reason for this is because of certain very fundamental conditions affecting science and technology during a war era.

In the first place, technology is itself so vast a subject and covers such a wide range of applied science that no man in the world is wise enough at any time to predict the future except for a very short distance ahead and in very limited sectors. Even so, he can not have any great assurance of being right.

During the war period there is added to the normal uncertainties the fact that no one in the world has the slightest idea of what kind of a world we are destined to live in when the show is over. Further, no one can say with certainty when the period of active warfare will cease and the period of peace will begin. Nor can any one say with assurance what changes in science and technology will occur during the interval of active warfare still ahead of us. The present tempo of applied science to the art of human destruction and defense against that destruction is

[1] The ninth address of the second series of conferences on "Postwar Goals and Economic Reconstruction" held under the auspices of the Institute on Postwar Reconstruction of New York University. Dr. Arnold J. Zurcher, director of the institute, presented Dr. Jewett and said in part: "We have not only an engineer this evening, but we also have, I suppose, one of the most distinguished engineers in the country. In a long list of persons who have been submitted to our attention as the kind of person whom we ought to invite, Dr. Jewett stood at the head, and we are very fortunate indeed in getting him to consent to come over here this evening and talk to us." This address, together with the discussion, will become part of a volume on "Postwar Goals and Economic Reconstruction," published by the university.

exceedingly great, and quite unforeseen things are still sure to arise.

Further than that, we have not only the vaguest of ideas concerning our own internal situation, but likewise not the slightest idea of what kind of neighbors we are going to have in this world. We don't know whether the so-called peace that will follow active warfare is really peace as we like to understand it, or is to be in fact merely an armed truce during which we are permitted a breathing spell in which to prepare for a further and greater conflict. When present hostilities formally cease our mass conception of the conditions of the future will have a controlling effect not alone on our adventures in technology, but likewise on our whole national life. If we are convinced that the peace is but an armistice, many of the controls that must obtain in war but which are abhorrent in peace will be accepted and our procedures will be ordered accordingly.

Again, irrespective of whether the years ahead are to be those of a lasting peace or of an armed truce, we are not likely to be completely free masters of our own house in much that we do technologically. Even in an ostensibly peaceful world, where the competition between races and peoples and nations is a purely commercial and economic one, what others elect to do will to a large extent govern our own acting in many directions and cause us to proceed in ways and in directions which we would not choose if left to our own devices. In other words, in our present highly mechanized world what others elect to do to a large extent controls what we must do.

We know that in the past the philosophies of different nations with regard to industry generally, and to applied science in particular, have varied widely, and in many cases have been quite different from our own. Here in America for the past forty or fifty years we have lived in the shadow of a fear of the size of industries—the fear that industries might grow to such dimensions as to be beyond the control of the state. Despite this lurking fear, which has crystallized in our several anti-trust laws, industries have grown to huge proportions notwithstanding the punitive measures and the restraints we have attempted to impose. So far as the applied science industries are concerned, this anomaly is the direct result of the fact that in many cases the maximum benefits, whether in price or in quality and quantity of services to the public which are inherent in the thing to be done, can only be obtained through big units. Examples of this are legion, and the fact that it is so seems to me an indication that subconsciously and despite our professed fears we have realized that our own interests lay in pursuing the course indicated by the factors of technology.

Whether or not this is correct, the fact remains that in many directions the vast achievements of war preparation simply could not have been had, had we not built up over the years our enormous units of production and trained untold thousands of men and women in their efficient operation.

Contrasted to our expressed anti-monopoly anti-trust philosophy, many countries (and England and Germany are, I think, among them) have developed under a different philosophy. While they, no more than we, would welcome the prospect of a situation where industry dominated the state, they have not hesitated to foster the growth of great units and to trust to the ability of political government to prevent their getting out of hand. Possibly they were more far-seeing than we, but largely, I suspect, they saw the possibility of war as a background drop more clearly than we in our isolated position were able to do. The fact that the industrial and manufacturing units which grew up under these two somewhat different philosophies were larger in the United States than elsewhere is of course the direct result of our peculiar geographic situation, and because of our size our huge domestic market, our high standard of living and our urge to develop our natural resources as rapidly as possible, all made for an industrial expansion for which there was no parallel.

Any attempt at the present time therefore, except in quite narrow sectors, to make a prophecy as to what is the promise of technology in the future, with any assurance that that prophecy is a reasonable one, is quite small. In consequence, I think that what we can do most profitably this evening is to take a look at some of the fundamentals, or what seem to be fundamentals, in the science and technology sector in any postwar era.

The best way to do this, I think, is to approach the matter by taking a look at the science and technology of the prewar era; to see what they now are and what they appear likely to be when at some indefinite future date we once again lay off our uniforms.

In what I am going to say, and I suspect in the discussion afterwards, I am proposing to use the word "technology" in its very broadest aspect to include not only the things which we normally think of as technology, which are mainly the applications of the physical sciences to utilitarian ends, but also the applications of the biological sciences. This seems to me both legitimate and desirable, since such things as medicine, public health and agriculture are really technology in the sense that they are utilitarian applications of fundamental biological science.

Moreover, there is an additional reason for doing this because in looking over the wide variety of science as applied to war activities there is a marked differ-

ence in the prospective postwar utilization of war science as between the biological and physical science domains. In other words, it seems to me that the chances of direct immediate and large-scale application in a peacetime economy are greater in those things which are based on technological developments of the biological sciences for war than in those which are based on the technological developments which are concerned primarily with the creation of instruments and instrumentalities of destruction.

The reason for this feeling is that the medical technologist during a war period is dealing primarily not with attempts to destroy life but in an endeavor to prevent that destruction and to save lives endangered by wounds or disease.

In a word, the biological science technologist in war is merely continuing in a different sector, on an enlarged scale and with clinical facilities not obtainable in peacetime, more nearly the normal course of everyday life. The result is that at the conclusion of hostilities practically all that he has learned will be immediately applicable to peacetime.

Contrasted to this, the vast majority of the technological applications of the physical sciences is either directly or indirectly concerned with the destruction of human life, and much of it has no prospective peacetime application.

All that we call "technology" is nothing but the application of fundamental science discoveries and the employment of scientific methods for useful or desirable purposes. Except incidentally, technology as such is not concerned in the production of new implements of knowledge. At all times, except during periods of active warfare, the scientific and technical world is divided roughly into two main groups. First, there are those who are concerned primarily with the exploration of the unknowns of science for the purpose of extending the boundaries of knowledge, developing new facts and learning more accurately the characteristics of old ones—all this without any particular thought as to their possible ultimate utility. For the most part this group is to be found in the colleges, universities and technical schools and in the great eleemosynary foundations. Incident to this work of pioneer exploration and as an integral part of it is the training of young men and women by indoctrinating them with the established learning of the past and with the methods of science by which it has been established. This is both to produce continuously a new group of investigators for the field of fundamental science or, as has been largely the case in the last two or three decades, to train men and women for a life in industrial research.

For this group it is a well-known fact that fundamental science flourishes best in a completely free intellectual world. In other words, a sine qua non in fundamental science is that there should be complete freedom of intercourse and discussion and the publication of results, so that all may have access to them. Men make discoveries; they publish their results; they meet together for discussion and argument, and they propound hypotheses and debate them. This freedom of intercourse is not merely freedom within a given nation but is a freedom among the scientific people of the whole world. It is all based on a common desire to know the truth about the things of nature; to extend that knowledge, and a realization that each individual's aspirations are helped by common group action.

The second division is that which we commonly designate as the sector of industrial research or technology. Here to a large extent the character and training of men, together with the implements and techniques which they employ, are the same or very similar to those in the fundamental science field. The objectives, however, are different, since they are concerned not with an extension of knowledge for its own sake, but in finding ways and means for new or better applications of fundamental science to the uses of mankind.

In this second group the modus operandi under normal conditions is likewise that of free intercourse and interchange of ideas. While this was not always the case, for the last thirty or forty years technologists have used the mechanisms of publication, scientific society meetings and free discussion in practically the same way as have those in the fundamental science fields. In addition to these agencies for spreading technological information there is in this field another form of publication, namely, that of patents, in which, while the publication spreads the knowledge to all who may care to read, it spreads it with limited property rights accorded by the state.

Now what happens to these two sectors when war enters the picture? Immediately there is a radical change in the whole situation. First, intercourse between the two contending parties ceases abruptly except for a small trickle of illicit and uncertain communication. Nor is this all. Within each nation the stark necessities of secrecy imposed by war impose great barriers of confidence for fear that items of importance to the enemy may leak out. For the time being complete freedom of interchange of information in any given field is taboo. Publication is circumscribed, patents are impounded, and men, whether in the field of fundamental or applied science, have largely to work in watertight compartments with intercourse only among those in the same compartment.

The result of course is that much unnecessary duplication of work ensues, much false work is done and all work is handicapped.

Further than this, fundamental science, which is the life blood not only of an expanding store of knowledge but likewise of an expanding technology, practically ceases for the time being. It ceases both because men and women have no heart for such work, but more because the trained scientist is immediately available for effective operation in the industrial field and is therefore drawn into the whirlpool of warfare.

We are prone to talk about this war as being a physicist's war in contrast to World War I, which was designated as a chemist's war. To a large extent it is not only a physicist's and chemist's war, but likewise a biologist's war, and most certainly an engineer's war.

Because of the nature of present-day warfare and the progress of science during the past two decades, it was inevitable that the field of physical science should be the one first affected. During the past two years, in this country, all production of new fundamental knowledge in the physical science field has substantially stopped because the men and women competent to work in those fields are for the moment engaged in the more urgent work of applying their knowledge and skills in the war effort. Gradually, but possibly not quite to the same extent, the same thing is happening in the field of the biological sciences. In these fields, in addition to a deflection of objective within the field itself, we have been witness to a large translation of biological scientists into the field of the physical sciences.

In both the physical and biological science fields there has been in addition a deflection away from those who would otherwise produce new knowledge to the field of intense instruction designed speedily to acquaint young men and women with highly specialized skills required in some phase of war activity.

The result of all this is that at the end of the war we are going to find ourselves with a frontier of fundamental knowledge which is not very much enlarged from that which existed at the beginning of the war. It will be somewhat different of course because the degradation in production has not been completely uniform around the periphery, it has not been completely stopped in some sectors, it has had some accretions of an incidental character supplied by our intense endeavor to expedite war developments, and because here and there, particularly in the field of the biological sciences, the mere necessities of war have made imperative a certain amount of fundamntal science research. By and large, however, I think it is safe to say that the period of active warfare is an almost complete stagnation of progress in the field of the fundamental sciences.

Further than that, we will return to a peacetime condition with a paucity of young men and women broadly acquainted with established knowledge and rigorously trained in the methods of scientific investigation.

Against this, however, is the fact that in some sectors there has been an intense technological development, some of which will have substantial peacetime applications. Likewise, we will have a huge number of men and women who have become skilled technicians in limited fields, and above all, a population which has a quite different and enlarged understanding of science and technology. Both by reading, and more particularly by participation in the armed services or in industry, literally millions of people who would otherwise have gone through life quite unacquainted with science, except its obvious external applications, will have some real understanding of it.

This is the general outline of the picture as it appears to me, and because of my position on the National Defense Research Committee and as president of the National Academy of Sciences I presume I have about as good an opportunity as any one to obtain a general view of the whole vast field of science and technology. It is a picture of substantial stagnation in the fields of fundamental science and of a large sector of technology concerned with matters of little importance in active warfare. Likewise, it is a picture of intense activity and astounding technological results in a relatively small number of sectors, many of which results have little prospect of salvage in the postwar era.

The reason that we have made such enormous technological progress in certain directions is due to the fact, first, that we have concentrated the scientific and technical ability of the entire nation in these directions; and second, because the normal restraints of a peacetime economy do not obtain for the time being. Money is no longer a factor of controlling force. Time and success in the undertaking are the controlling essence of the job, and money as such is a very secondary consideration. Further, for the time being men and women are content to labor harder than they ever labored before and under conditions of restraint imposed by the necessities of war which they would not tolerate in normal times. For the moment every one in the field of science and technology has a single common objective which transcends in importance all other objectives, and which in addition they all desire to achieve in the shortest possible time.

Now what will happen when the armistice is signed? The minute that war is over, and particularly if the

prospective conditions of the peace are such as to indicate a long period of freedom from hostility, we are bound, I think, to see an immediate disintegration of the present machinery of science and technology. Men and women will yield to the deep-seated urge to return to their erstwhile modes of life, and in addition no one will wish longer to devote time and energy to objectives which have lost their reality. Scientific men will wish to return to life in a free intellectual world, there to pursue the quest for new knowledge. Industrial research men and technologists will hasten to take up again the things that once interested them and to expedite filling in the gaps made by the inroads of war and the forced laying aside of promising new applications of science. There will be a dearth of highly trained men for fundamental science research for general application, and a large number of men trained in specific applications. Much of what we have done during the war period will be of no peacetime value because it is concerned wholly with the things of war.

I have already mentioned the fact that the nature of this war is training millions of people to a different understanding of science and technology. Whether or not these men and women continue in some sector of fundamental or applied science, their number will be so great that their mass desire is bound to have a controlling effect on the things we do, and more particularly on the way we do them, especially in the field of technology. No one can say in advance just what this effect will be or how it will be evidenced either politically or economically.

Now I am almost through with my thirty minutes of talk. There are, however, one or two other things which I would like to lay before you as elements in the realm of uncertainty in which I think we are going to find ourselves in the beginning at least of the postwar era.

I mentioned earlier the uncertainties which would confront us of not knowing what kind of a world we are going to live in, or what the other fellow is going to do, which will force us, whether we like it or not, to do things which we might otherwise prefer not to do.

One thing which we do not and can not now know is the relation of political government to the development of technical applications of scientific knowledge. At the present time, in the midst of war, political government must of necessity control what we do and how we do it. It is the only way that a nation can wage war successfully. But coincident with the realization of this necessity we are all increasingly conscious of the limitations and deficiencies of attempting to control so vast a thing as a nation's technology in a single narrowly centralized government. It is too vast a thing to be administered effectively by any limited group having merely the clairvoyance with which God has seen fit to endow men.

On the other hand, there are certain applications of science which are of such a character that it is difficult to see how they can be carried on effectively except under some form of government support or control. If this is so, it would appear that in certain sectors at least government in the postwar era will play a bigger part in the development of science and technology than it has in the past.

An example of this is to be found in things like agriculture, where the problems are numerous and involved and where those to be benefited are a myriad of small units, each one of which can derive maximum benefit from the applications of fundamental science knowledge only through some form of cooperative effort, such as government or a government supported agency can afford.

In connection with the ultimate prospective place of political government in the field of science and technology, and in connection with a large part of current discussion about planned direction of research, there is a vast amount of popular misconception as to the role and part played by the director, whether he be a government official or an industrial research director. Any of us who have had wide experience as industrial research directors (and I have had nearly forty years of such experience) know that the director and his immediate subordinates do not direct the work of their laboratories or engineering departments in the way many people think they do. If they were wise enough to plan and direct the work in the detail which many assume, the size of the organization and character of its makeup would be drastically changed.

Actually what the director and his immediate subordinates do is to provide a proper setup in which men with creative ideas can work freely; to map out the general fields in which progress appears to lie, and finally to weigh the results of research work together with many other factors in deciding how to proceed. The real creative ideas originate hither and yon in the individual members of the staff and no one can tell in advance what they will be or where they will crop up. Every industrial research director has had the experience of having presented enthusiastically a radically new idea about the prospects of which he himself was skeptical. In such circumstances and unless the idea can be shown to be demonstrably impractical, there is only one safe thing that the director can do, namely, to afford opportunity to the originator to develop his idea, with the knowledge that if the individual is right and the director wrong good will result, and per contra, if the director is right and the

individual wrong, the latter will have satisfied himself and not have something which he thought a valuable thing discarded through an act of authority.

As an example of how impossible it is, even with simple things, to forecast the future, I have often thought of how infinitesimally small would have been the chance of any man or group of men, except the one who actually had the idea, planning to invent the common zipper.

In conclusion I should like to mention merely two or three more or less specific things which may be helpful in our later discussion as to fields where it appears that a considerable part of our war science and technology may find substantial postwar application.

I suspect that the field of aviation may be prominent in your minds. There is no question that because the airplane has shown itself to be a powerful military tool all sectors of aeronautical development have been pushed forward during the past three or four years infinitely faster than would have been the case without the impetus of war. This has been true not only as regards the airplane itself and its power plant, but likewise as regards a myriad of adjunct and incidental equipments which are needed for its safe and efficient operation. The same is true of development in those sectors of meteorology which are basically concerned with the character of the medium in which the airplane must operate.

Basically, however, the great bulk of the advances which have been made have not involved new fundamental science discoveries or even new techniques but merely a more intense utilization of existing knowledge and application of established techniques. What we have done in this field has been to concentrate a huge number of trained scientists and engineers on a relatively limited number of definite objectives and, with little or no regard for money cost, hammer out progress in the shortest possible time.

Much of what has been accomplished is with possible slight modification directly applicable to civil aviation, and many of those who have become skilled in the design, manufacture, maintenance and operation of military heavier-than-air vehicles can pass smoothly from the military to the civil sector.

Another and possibly the most spectacular of the wartime technologies is in the field of electronics. Here again, so far as I am aware, little that is fundamentally new has been produced, and yet because of the urgency of the military necessity perfectly astounding technical progress has been made. Here, as in the field of aeronautics, much of the effort has been directed to things of great importance in military operations but of minor importance in prospective civil usage. Much, however, is equally applicable. The much discussed radar devices are an illustration of this. As you know, these devices are an electrical means for detecting objects at a distance with great accuracy as to direction and distance and without regard to atmospheric conditions, such as would forestall the use of acoustical or optical phenomena. Fundamentally, radar does not involve principles which have long been recognized by science but, practically speaking, the application of such knowledge has compressed into two or three years what in normal times it might have taken a decade or two to do.

There is not the slightest reason to doubt that in the postwar era radar in various forms will serve civil needs in a multitude of ways. Collision of ships at sea in darkness, fog and rain should be a thing of the past. Likewise, collision of airplanes with mountains or structures should be uncommon rarities resulting merely from human neglect or the occasional unavoidable failure of mechanical and electrical things.

Finally, I would call your attention again to the fields of medicine and nutrition as fields in which scientific and technical progress under the mighty stimulus of war necessity will have a large direct beneficial application in the postwar era. As I pointed out, these fields, because they are concerned primarily with the saving rather than the destruction of life, have been able to develop during the war, under more nearly normal conditions of free intercourse than has been possible in the fields of the physical sciences. While some secrecy has had necessarily to be maintained in specific cases where the results were likely to have great military value, there has on the whole, I think, been a fair amount of free dissemination of progress in the biological sciences.

Added to this is the fact that war conditions present to the biological technician clinical benefits of a magnitude and kind which can not possibly be approached in normal times. Vast numbers of human beings are assembled together under the regimen of control not otherwise attainable and with opportunity for adequate clinical experimentation involving adequate control groups which not even the largest medical center can provide.

In peacetime the scientist or clinician is likely to be hampered by the desires of the subject. No such inhibition is present in a military organization.

A few new drugs may have been developed and more which had already given promise have been subjected to extensive trial and their merits or demerits largely determined. The present largely discussed penicillin is one of these, and vast preparations have been made for its quantity production from its original natural source. Even here, and in the allied field of possible synthetic production, the techniques which have been employed are not essentially the result of new knowledge but of old knowledge applied in new ways and on an enormous scale.

SCIENTIFIC RESEARCH AND THE WAR EFFORT OF U.S.S.R.

By J. G. TOLPIN
UNIVERSAL OIL PRODUCTS COMPANY, CHICAGO

IN an exchange of letters between Professor Lena Stern, the only woman member of the Academy of Sciences of the U.S.S.R., and Sir Henry Dale, president of the Royal Society of London, which was published in *Nature* of July 17, 1943, Professor Stern declares:

> The work which is being carried on so intensively at our factories and mills, in our research institutes, in our university departments and in our war hospitals is wholly directed towards helping the front, to perfecting the arms of war, to protecting the health of our fighters.

This statement is certainly a source of encouragement, especially when the nature of some researches which Professor Stern apparently has in mind is considered. The programs of research had been conceived and begun before the actual outbreak of the present war; however, despite the fact that the Academy of Sciences of the U.S.S.R. was moved to Sverdlovsk in the Ural Mountains, and many of its institutes, laboratories and publications scattered, these programs are said to be carried out for the most part as originally scheduled. Reports indicate lively research activity going on in these institutes, as well as in the provincial divisions of the Academy of Sciences, such as the Ural Division and the Georgian Division.

S. I. Vol'fkovich, corresponding member of the Academy of Sciences of the U.S.S.R., recently published a partial roster of scientists and engineers who were awarded Stalin prizes, ranging from 25,000 to 100,000 rubles, for outstanding achievements resulting from their researches carried out in 1940 and 1941. The ruble is not quoted on exchanges outside the U.S.S.R.; the official Soviet rate of exchange is five rubles to the dollar. Although the issue of the *Bulletin of the Academy of Sciences of the U.S.S.R.* in which the article by Professor Vol'fkovich appears was published in Kazan a little less than a year ago, it did not reach this country for quite some time because of shipping difficulties.

Stalin prizes have been awarded by a special committee of the Government since 1939 for important accomplishments in the sciences, the arts, technology and the humanities. Some of the chemists mentioned in the last two lists of awards have published the results of much research in the fields of study for which they were honored, and the nature of their work is well known. Others have been engaged in research of purely military significance, and little has been published of their work. The diversity of subjects covered by the present-day chemical research in the U.S.S.R. is illustrated by the reports of the sessions of the department of chemistry of the Academy of Sciences. The February, 1942, session of this department was devoted exclusively to the research of the Radium Institute, in commemoration of the twentieth anniversary of this institute; the March, 1942, session dealt with infrared spectrum analysis and the mechanism of detonation of explosives; the May, 1942, session was partly devoted to a paper reviewing the scientific works of Professor Gilbert Newton Lewis, of the University of California, who was elected at that session an honorary member of the Academy of Sciences of the U.S.S.R.; and the July session was concerned with anodic oxidation of aluminum and its alloys. In addition, results of research on acetylene derivatives, on platinum metals and on other subjects were reported.

Ample assistance is provided by the state for every worthwhile research project. Although the number of college-trained chemists in the U.S.S.R. was estimated at the beginning of 1941 to have reached 50,000, indications were available that there were vacant positions for chemists, since the third Five-Year Plan (1938–1942) called for a greater development of the chemical industries than in any other period and was, in fact, referred to as the Chemical Five-Year Plan. The Soviet chemical industry was in a large measure created in the period between the two World Wars, and Soviet estimates show that in 1941 only 4 per cent. of the production of the chemical industry came from plants in existence before the industrialization of the country was begun.

The editors of the *Journal of Applied Chemistry of the U.S.S.R.* stated in a recent issue that on the eve of the present war (1941) there were over forty research institutes serving exclusively the chemical industry of the U.S.S.R. and seventy special colleges or college departments for training chemical engineers. These colleges had an enrolment of 35,000–40,000 students and graduated on the average 5,000 chemists and chemical engineers a year.

Many of the scientists whose work gained them distinction are well known to their colleagues abroad. Their achievements deserve, however, more general notice on the part of American scientists, and this account purports to call attention to some of these researches, particularly in the fields of chemisty and

chemical technology. The following abbreviated list shows some of the accomplishments which won Stalin prizes for the scientists responsible for them:

A. N. Bakh, president of the Mendeleev Chemical Society and director of the Biochemical Institute: Research on biochemistry; specifically, application of the results gained in the research on the action of ferments and on the chemistry of breathing to industrial biochemical processes. The results of this work were helpful in raising crops more resistant to cold and drought, improving the production of tea, baking bread, making wine, storing fruit and vegetables and drying cereals harvested before maturity. The last named is stated to be of importance for harvesting in rainy years. Perhaps it also had military significance when grain was to be harvested before time in order to prevent it from falling into the hands of the enemy.

A. E. Favorskiĭ, member of the Academy of Sciences and professor at the Leningrad University: Development of an improved method of synthesis of isoprene rubber, a result of Favorskiĭ's numerous researches on unsaturated hydrocarbons, which were published during the last fifty years. The award for this work shows the great interest the Soviet Government has in the research on rubbers other than butadiene rubber, which is the basis of the Soviet synthetic rubber industry.

N. D. Zelinskiĭ, member of the Academy of Sciences and director of the Institute of Organic Chemistry: Conversion of petroleum constituents into aromatic hydrocarbons, including toluene, and also into alcohols, aldehydes, etc.; research on catalytic cracking. Zelinskiĭ has received awards for numerous other achievements in recent years.

B. M. Rybak and co-workers, employed by the petroleum industry of U.S.S.R.: Development of improvements greatly increasing the manufacture of aviation gasoline.

B. Z. Rudoĭ, of the Institute of Mineral Fuels: Apparatus for the determination of the octane rating of motor fuels which is simpler and cheaper than the Waukesha engine.

N. N. Semenov and co-workers. Semenov is a member of the Academy of Sciences and director of the Institute of Chemical Physics: Theory of chain reactions and theory of combustion. These theories are stated to have led to methods of determining intermediate products in combustion processes and to the discovery of a number of important phenomena. The velocity of propagation of flame and inflammability limits can be predicted on the basis of the theory of combustion, and detonation can be calculated. The theory of combustion is also helpful in explaining the phenomena occurring in the combustion of fuel in internal combustion engines.

A. N. Kuznetsov, M. M. Faĭnberg and co-workers, of the Leningrad Mining Institute and the Karpov Institute of Physical Chemistry: Invention of new explosives from abundantly available raw materials, the value of which was recognized in industry and on the battle front.

I. V. Grebenshchikov, member of the Academy of Sciences and director of chemical research at the Optical Institute: Theory of the structure of glass, which describes the glass as a mesh formed by anions, with the cations being capable of more or less free motion. Application of this theory is stated to have led to the development of important borosilicate glasses of great value in optical work. It is used in almost all Soviet plants making optical war equipment.

P. P. Budnikov and co-workers. Budnikov is a member of the Academy of Sciences and professor at the Institute of Chemical Technology in Khar'kov: Development of anhydrite cement, which is being manufactured on a large scale and is said to be an important building material.

N. P. Bogoroditskiĭ: Invention of an improved "ultra-porcelain" insulating material, which is already being produced on a large scale by the radio industry.

S. I. Vol'fkovich and co-workers, of the Institute of Fertilizers and Insectofungicides: Research on processing native apatites and phosphorites providing for complete utilization of their phosphorus, calcium and fluorine. This research led to methods of production of highly valuable fertilizers, control of agricultural pests and methods of production of rare earths of the cerium group.

A. N. Frumkin, director of research at the Colloid-Electrochemical Institute and member of the Academy of Sciences: Theory of electrode processes based on research on the structure of double electrical layers; research on atom layers adsorbed on electrodes, electrokinetic behavior of metals, overvoltage and similar phenomena. This work is of importance in the understanding of corrosion, chemical sources of electrical current and industrial electrolysis.

L. I. Mandel'shtam, member of the Academy of Sciences: Further developments in the application of Raman spectroscopy. The phenomenon of combination scattering of light was discovered by Mandel'shtam and G. S. Landsberg simultaneously with Raman.

S. Z. Roginskiĭ, Institute of Chemical Physics. Roginskiĭ is a corresponding member of the Academy of Sciences: Theory of catalysis. Roginskiĭ established the high significance of minute quantities of impurities on the surfaces of catalysts for their specific effects.

N. S. Kurnakov and co-workers. N. S. Kurnakov was the head of the Institute of General and Inorganic Chemistry and a member of the Academy of Sciences: Physicochemical method of analysis, characterized by application of geometrical methods to the study of the relationship between composition and properties of equilibrium systems. This method, developed by the late Professor Kurnakov, led to the prognosis of rich deposits of potassium, magnesium and other salts in the Soviet Union; it also found wide application in research on and the manufacture of alloys.

G. I. Nosov and co-workers, of the Magnitogorsk Metallurgical Combine and the Research Institute 48: Development of a new type of armor steel and of a method for its production.

V. V. Mikhaĭlov and co-workers of the Ural Division of the Academy of Sciences and the Ural Metallurgical Industry: Metallurgy of carbon ferrochromium in blast furnaces.

M. N. Sobolev and co-workers: Metallurgy of ferrovanadium.

E. I. Antonovskii and co-workers, of the Balkhash Copper Combine and the Leningrad Mining Institute: Development of a successful method of producing molybdenum.

F. F. Vol'f and co-workers, of the Ural Aluminum Industry. Vol'f is professor at the Ural Industrial Institute: Development of a method of large-scale manufacture of aluminum from Ural bauxites.

P. A. Rebinder, corresponding member of the Academy of Sciences: Research on surface phenomena and the effect of small additions of active substances on the properties of solids. This work led to the development of new cutting fluids which facilitate the machining of metal. Substances were also developed as a result of these studies which reduce the hardness of geologic formations in drilling.

A. P. Belopol'skii and co-workers, of the Institute of Fertilizers and Insectofungicides: Development of a new method of manufacture of soda and ammonium sulfate from mirabilite, resources of which are very extensive in the U.S.S.R.

G. K. Boreskov and A. G. Amelin, of the Institute of Fertilizers and Insectofungicides: Improvements in the contact method of sulfuric acid manufacture through perfection of the method of preparation of the vanadium catalyst and the refining of the gases handled.

I. N. Usyukin: Suggestion of a method of intensification of the nitric acid industry, which is stated to have high defense value.

Z. A. Rogovin and co-workers, of the Mendeleev Institute of Chemical Technology and the Institute of the Cotton Industry: Invention, now being used by industry, of a simple method of making cloth fire resistant and water repellent.

B. A. Dolgoplosk and B. A. Dogadkin: Development of a method of preparation of latex from synthetic rubber.

I. N. Nazarov, Institute of Organic Chemistry: Synthesis of vinylacetylene derivatives used by optical, machine-building, and other industries as adhesives.

A. I. Kiprianov, corresponding member of the Academy of Sciences: Invention of cyanine dyestuffs and photosensitizers.

O. Yu. Magidson, of the Chemico-Pharmaceutical Institute: Inventions in the field of pharmaceuticals, including sulfamide preparations.

A. V. Vyshnevskii: Development of the widely used method of novocaine anesthesia and a new type of bandage.

In addition to the impetus given to chemical research by the Stalin prizes granted by the Soviet Government, the Chemical Society of the U.S.S.R. also actively encourages research. A Russian chemical journal just received contains a news account of a contest conducted by the Mendeleev Chemical Society for the best research in chemistry. The researches offered were to be judged on the basis of the following criteria: (a) importance to the war effort; (b) significance for the national economy; (c) novelty of methods used and objects of the investigation selected; (d) quality of the work carried out; (e) theoretical value of the data obtained. The day on which the researches were to be submitted was postponed from January 1 to May 1, 1943. Ten prizes, ranging from 1,000 to 5,000 rubles, and ten certificates of merit were to be awarded.

SCIENTIFIC EVENTS

PRESIDENTIAL ADDRESS AT THE ANNUAL MEETING OF THE ROYAL SOCIETY

SIR HENRY DALE, in his presidential address to the annual meeting of the Royal Society, urged that plans for the reconstruction of London should include provision for a spacious central home for the scientific societies.

There was a large gathering, and at an informal luncheon preceding the meeting the president welcomed the presence of General Smuts, a fellow of the society since 1930, and many guests, including Mr. Attlee, Sir John Anderson, Lord Woolton, R. S. Hudson, L. S. Amery, W. S. Morrison, the High Commissioner for India and the High Commissioner for New Zealand.

Reviewing the history of the society and the different quarters it had occupied, Sir Henry Dale recalled that the society remained for 50 years from its foundation a tenant of rooms in Gresham College, till in 1710, when Isaac Newton was president, it acquired the house in Crane Court, off Fleet Street, which was its home for another 68 years. In 1778 it was granted quarters in Somerset House, where the accommodation was regarded from the first as inadequate and where the society remained for nearly 80 years.

He described proposals then made for bringing the major scientific societies under one roof—the Royal, Linnean, Geological, Astronomical and Chemical Societies—centralizing and coordinating their libraries without any attempt at fusion. He said the acquisition by the Government of Burlington House, Piccadilly, provided what seemed to be the ideal opportunity of giving effect to such a plan, and the Prince Consort, with a vision of the future meaning of science far in advance of his time, privately urged the five societies to press their claim to the site.

There was much rival lobbying in those days, and a magnificent opportunity to give London a scientific

center worthy of the nation's effort was lost. The Government had already made some kind of commitment to the Royal Academy so far as the mansion of Burlington House was concerned.

In 1867 evidence came to the society, first through a statement in *The Times,* that the Government had decided to give the Royal Academy a permanent lease of Burlington House, and the right to extend northwards by building over its gardens. About the same time the large building which now fronted on Burlington Gardens was begun, and was opened by Queen Victoria in 1870.

The Royal Society began to find its present quarters inadequate as early as 1900. Its accommodation was still the same to-day. Its walls could not find room to hang the society's important collection of scientific portraits. Its great library was badly overcrowded, and it continued to grow Library pressure, in fact, was felt to varying degrees by all the societies there, and he thought it was still true that no scheme would be able to deal with the problem efficiently, and to meet modern needs without disturbing historic associations, which did not include some kind of central coordination of libraries.

REPORT OF THE INTERNATIONAL BOARD OF INQUIRY FOR THE GREAT LAKES FISHERIES

RECOMMENDATION for joint action by the United States and Canada to restore the depleted fisheries of the Great Lakes is made in a report of the International Board of Inquiry for the Great Lakes Fisheries issued after the completion of a two-year survey and now made available to the public.

The board, consisting of two members from the United States and two from Canada, was appointed by the governments of the two countries in 1940 to study the critical situation of the Great Lakes fishing industry and to make recommendations for its preservation and development.

Although the Great Lakes are the principal source of the U. S. supply of fresh-water fish, the more valuable species are now much less abundant than formerly and some no longer support fisheries.

The Great Lakes sturgeon, source of caviar, has been commercially extinct for many years, as are several species of chubs in certain waters. Whitefish, once abundant in all the lakes, is now taken only in certain restricted areas. Lake trout, yellow perch, yellow pike perch and blue pike are among other species threatened locally.

While the total yield of the lakes—some 110,000,000 pounds annually—has not declined greatly during the past half century, less valuable species are now making up the bulk of the catch because of the decline of the choicer food fishes.

Canada's share of the Great Lakes fishery yield is some 25 to 30 million pounds or about a fourth of the total. Of the U. S. catch, about 20 per cent. is made in Lake Superior, 27 per cent. in Lake Michigan, 16 per cent. in Huron, 35 per cent. in Erie and 2 per cent. in Ontario.

During the past sixty years at least twenty-seven international or interstate conferences have been held in an effort to bring about an effective system of regulations for the fisheries of the Great Lakes. The most recent of these conferences, held in 1938, was called by the Council of State Governments and led to the establishment of the International Board of Inquiry.

In a supplement to the report of the full board the United States members, Dr. John Van Oosten, of the U. S. Fish and Wildlife Service, and Hubert R. Gallagher, of the Council of State Governments, cited as precedents for international control of a living resource the Migratory Bird Treaty, the International Fisheries Commission for the restoration of the Pacific halibut and the International Pacific Salmon Fisheries Commission. The Migratory Bird Treaty and the Halibut Commission have already achieved recognized success. The Salmon Commission, after a preliminary period of investigation, will soon undertake regulation of the sockeye salmon fishery of the Fraser River and Puget Sound.

According to the report, the majority of the U. S. fishermen of the Great Lakes favor unified control of the fisheries and are not opposed to an international treaty as a means of attaining it. A poll of fishermen conducted by the board showed that 93 per cent. favored uniform regulation and 68 per cent. expressed approval of negotiating a treaty with Canada.

THE SCIENTIFIC STUDY AND DEVELOPMENT OF PHYSICAL MEDICINE

THE first center for the scientific study and development of physical medicine as a branch of medical practice has been set up in the Graduate School of Medicine of the University of Pennsylvania under the auspices of the National Foundation for Infantile Paralysis. The foundation has made a grant of $150,000 for the five-year period from January 1, 1944, to December 31, 1948.

A statement made by Dr. Basil O'Connor, president of the foundation, reads:

> We believe this to be one of the most important steps which the National Foundation has taken. It will not only advance the treatment of infantile paralysis, but of many other diseases as well.
>
> This is but the first step in a program which should afford a scientific basis for physical therapy and lead to the establishment of a more desirable teaching program.
>
> If this branch of medicine can be given a sound professional standing, medical men of the highest caliber

will be attracted to it and practitioners will utilize fully its advantages. If research and study show there is little or no basis for treatment by some of the physical agents, then an equally great service will have been rendered, even though it be principally negative in character.

Physical medicine plays a most important part in the treatment of infantile paralysis. Since it was first organized, the National Foundation has been continuously concerned with this phase of treatment. It has spent during the past six years over $350,000 to educate and train technicians in physical therapy. An additional $364,000 has been granted to laboratories and universities to study many problems in physiology and medicine having a close connection with the practice of physical therapy, but never before has it been possible to combine in one place both medical research and teaching in this important field.

The Center for Research and Instruction in Physical Medicine will include:

A center for the development of physical medicine as a scientific part of the practice of medicine.

A training center for medical leaders and teachers in this branch of medicine.

A school for training technical workers under the guidance of such professional and scientific leadership, the school to be only incidental to and dependent upon the first two purposes.

The departments of anatomy, physiology, pathology and other basic sciences of the University of Pennsylvania will cooperate in this proposed program. The general direction will be assigned to Dr. Robin C. Buerki, dean of the Graduate School of Medicine.

LICENSING THE REPUBLICATION OF FOREIGN ORIGIN MATHEMATICAL TABLES

THE Office of Alien Property Custodian has licensed, during the past several months, the reprinting of scientific and technical books, of enemy origin, which are not available in a quantity sufficient to meet the demands of the wartime operations of science and industry.

In this connection the custodian has received several queries concerning the possibility of licensing the republication of additional Mathematical Tables. Licensed for republication and now available for purchase are Jahnke and Emde, "Funktionentafeln mit Formeln und Kurven," 1938; Jean Peters, "Siebenstellige Werte der Trigonometrischen Funktionen," 1938, and his "Achtstellige Tafel," 1939.

Before a definite decision can be made regarding the licensing of additional Mathematical Tables for republication, it is necessary for the custodian to be informed about the extent of the need of such tables and to receive suggestions of specific titles for consideration. This can be accomplished if suggestions of specific significant tables are sent by individuals to the Office of Alien Property Custodian, Washington, D. C. These suggestions or any inquiries should be addressed to the undersigned.

HOWLAND H. SARGEANT,
Chief, Division of Patent Administration
OFFICE OF ALIEN PROPERTY CUSTODIAN,
WASHINGTON, D. C.

GRANTS OF THE COMMITTEE ON RESEARCH OF THE AMERICAN MEDICAL ASSOCIATION

THE following grants have been made by the Committee on Scientific Research of the American Medical Association:

Reginald Fitz, Peter Bent Brigham Hospital, Boston, study of exophthalmic goiter.

Arthur M. Lassek, Medical College of the State of South Carolina, effect of hemiplegia on the pyramidal tract.

Warren O. Nelson, Wayne University, lipids in the adrenal cortex.

Frederick M. Allen, New York Medical College, problems of shock.

Meyer M. Harris, New York State Psychiatric Institute, muscular disease.

Deborah V. Dauber, Michael Reese Hospital, Chicago, atherosclerosis in the chick.

Wesley W. Spink, University of Minnesota, staphylococcus infection.

Roland K. Meyer, University of Wisconsin, antihormones.

Katharine M. Howell, Michael Reese Hospital, Chicago, amebic dysentery.

L. R. Cerecedo, Fordham University, vitamin B deficiencies in rats and mice.

S. A. Thompson, New York Medical College, omental grafts in the thorax.

Paul Thomas Young, University of Illinois, food preferences in the rat.

Ulrich Friedmann, Jewish Hospital of Brooklyn, tetanus toxins.

I. M. Tarlov, New York Medical College, regeneration of cauda equina.

PROFESSOR FRANK R. LILLIE AND THE MARINE BIOLOGICAL LABORATORY

THERE is printed in the *Collecting Net* the following appreciation of the services of Dr. Frank R. Lillie to the Marine Biological Laboratory at Woods Hole:

In the history of the Marine Biological Laboratory the names of two men are pre-eminent: Dr. Whitman, who with prophetic insight, envisioned this institution as a national center of research in every department of biology, and Dr. Lillie, who transformed that vision into reality. Coming to Woods Hole first in 1891 as an investigator receiving instruction, Dr. Lillie, with Dr. Whitman, organized the course in embryology in 1893. He was appointed assistant director in 1900 at a time when the fortunes of the laboratory were at a low ebb, director in 1908 and president of the corporation in 1926, after the successful conclusion of the campaign to obtain new build-

ings and an endowment. During the period from 1900 to 1942, when he resigned from the presidency, the Marine Biological Laboratory developed from a struggling organization to its present position as the leading cooperative laboratory of the world.

It is, of course, true that only by the devoted work of the members of the corporation and the active interest of its many friends, could such an end be reached; but it is equally true that without wise guidance this effort would have failed. From the beginning, when Whitman, against every force and discouragement, fought for the principles of cooperation and independence, this laboratory has pursued its steady course, adapting itself wisely to new conditions as they arose, but always holding to those basic ideals. During his fruitful years as director Dr. Lillie frequently stressed these principles. "Our purpose," he wrote, "is essentially ideal, and its pursuit demands our best efforts and our loyalty." And again, "We have laid the principle of cooperation at our foundation, and we have attempted to build it into every one of our activities." In this course he has always quietly led. There has never been any thought of division since he has been in charge. Here lies his strength, and here lies the secret of the continued success of the laboratory.

In accepting his resignation from the presidency, the corporation and the trustees are rejoiced that he will continue his connection with the laboratory as president emeritus. We extend to him and to Mrs. Lillie, who has so ably assisted him in the development of the Marine Biological Laboratory, our grateful thanks, and we pledge to him our best efforts to continue the work which he has so long and so wisely guided.

C. E. McClung
E. G. Conklin
Charles Packard

SCIENTIFIC NOTES AND NEWS

Dr. Anton J. Carlson, emeritus professor of physiology of the University of Chicago, has been elected president of the American Association for the Advancement of Science.

Dr. Arno S. Luckhardt, professor of physiology at the University of Chicago, who first used ethylene gas as an anesthetic, has received the Callahan Memorial award of the Ohio State Dental Society, "for his contribution to humanity and the healing arts."

Dr. N. G. Cholodny, professor of plant physiology in the University of Kiev, has been awarded the Charles Reid Barnes Life Membership in the American Society of Plant Physiologists. The award, made only once every five years, is given to a foreign plant physiologist. An American life membership was awarded to Dr. W. W. Thomas, of Pennsylvania State College, who is known for his work on the mineral nutrition of plants.

The Kentucky Academy of Science announces that the 1943 King Award of $50, made annually by Mr. Fain W. and Mrs. Blanche B. King, of Wickliffe, Ky., to the author of the most meritorious paper presented at the annual meeting of the academy, will go to M. J. Astle, Wendell P. Cropper and Stanly P. Stephenson for their joint papers on "Polarographic Investigation of Some Nitrocresols" and "Polarographic Investigation of Hydrogen Bonding in Nitrodihydroxybenzenes." The work was done in the department of chemistry of the University of Kentucky, and the papers were presented at the thirtieth annual meeting of the academy held on April 24 at Louisville, Ky. The award was established by Mr. and Mrs. King in 1939, to be made for five years. This marks the fifth and final presentation.

Dr. Wilmer Souder, principal physicist of the National Bureau of Standards, Washington, D. C., was elected an honorary member of the American Dental Association at the recent meeting held in Cincinnati.

At the tenth annual meeting of the American Academy of Tropical Medicine, held on November 17 in conjunction with the Southern Medical Association at Cincinnati, the presidential address, entitled "The South American Scene," was delivered by Dr. Lewis W. Hackett, assistant director of the Division of International Health of the Rockefeller Foundation. At this meeting the third Theobald Smith Gold Medal of the George Washington University was presented to Colonel Charles F. Craig, U.S.A. (retired). The following officers were elected for 1944: *President,* Colonel Edward B. Vedder, U. S. A. (retired), Oakland, Calif.; *Vice-president,* Dr. Mark F. Boyd, Tallahassee, Fla.; *Secretary,* Dr. Ernest Carroll Faust, New Orleans; *Treasurer,* Lieutenant Colonel Thomas T. Mackie, Washington, D. C.; *Councilor* (for five-year term), Brigadier General James S. Simmons, Washington, D. C. The following were elected to membership: Dr. Harold W. Brown, Dr. J. A. Curran, Dr. J. S. D'Antoni, Dr. George K. Strode and Dr. Robert Watson.

At the joint meetings of the American Pomological Society held at St. Louis, Mo., on December 13, 14 and 15, Professor T. J. Talbert, chairman of the department of horticulture and forestry of the College of Agriculture of the University of Missouri, was reelected president of the society.

At the recent meeting of the Indiana Branch of the Society of American Bacteriologists, the following

officers were elected: *President,* Dr. Norman J. Miller, Mead Johnson Company; *Vice-president,* Dr. James A. Reyniers, University of Notre Dame; *Secretary-Treasurer,* Dr. L. S. McClung, Indiana University, and *Director,* Deliah Metz, Indiana State Board of Health.

THE following officers were elected for 1944 at the annual meeting of the Board of Governors of the Institute of Medicine of Chicago: *Honorary chairman of the Board of Governors,* Dr. Ludvig Hektoen; *Chairman of the Board,* Dr. William F. Petersen; *President,* Dr. Andrew C. Ivy; *Vice-president,* Dr. Harry S. Gradle; *Secretary,* Dr. George H. Coleman, and *Treasurer,* Dr. Grant H. Laing. The newly elected members of the Board of Governors for terms of five years each are Drs. Bowman C. Crowell, Herman L. Kretschmer and Eric Oldberg.

DR. HOWARD C. TAYLOR has been appointed chairman of the department of obstetrics and gynecology of the College of Medicine of New York University. Dr. Taylor has been a member of the faculty since 1935.

HERBERT F. SCHWARZ, since 1921 associated with the American Museum of Natural History, has been appointed chairman and curator of the department of insects and spiders to succeed the late Dr. Frank E. Lutz.

BENJAMIN PARRY, first assistant to Dr. James H. Kimball, who died on December 21, has been appointed his successor as chief meteorologist of the New York Weather Bureau.

J. LOUIS NEFF, East Williston, Long Island, N. Y., has been appointed to the newly established position of executive director of the American Society for the Control of Cancer, of which Dr. Clarence C. Little is managing director.

DR. VALY MENKIN, formerly assistant professor of pathology at the Harvard Medical School, is now associate in research at the Fearing Research Laboratory of the Free Hospital for Women at Brookline, Mass. In this capacity he is continuing his studies in general pathology with particular emphasis on inflammation and cancer research.

DR. SIMON EDWARD SULKIN, instructor in bacteriology and immunology at the School of Medicine of Washington University, St. Louis, has been placed in charge of the virus research laboratory now being organized at the medical school of the Southwestern Medical Foundation, Dallas.

FIVE physicians have been appointed by President Roosevelt members of a commission to recommend possible changes in physical, mental and moral qualifications for admittance to the armed services. These are Rear Admiral Ross T. McIntire, Surgeon General of the Navy; Major General Norman Kirk, Surgeon General of the Army; Dr. Alan C. Woods, ophthalmologist-in-chief of the Johns Hopkins Hospital, Dr. Frank H. Lahey, surgeon-in-chief of the Lahey Clinic, Boston, and Dr. Edward A. Sprecker, professor of psychiatry at the University of Pennsylvania.

DR. THOMAS R. WOOD has been appointed a member of the staff of the section of organic chemistry of the Central Laboratories at Hoboken, N. J., of the General Foods Corporation.

DR. FRED OBERST, biochemist for the U. S. Public Health Service in Lexington, Ky., has recently been appointed chief of the biochemical division of the Research Laboratories of the Wm. S. Merrell Company.

THE British Minister of Production has appointed Sir Charles Hambro, chairman of the Great Western Railway, as United Kingdom member of the Combined Raw Materials Board and head of the British Raw Materials Mission in Washington. He succeeds Sir Clive Baillieu, who has held these posts since the formation of the two bodies, and had previously served as head of the British Purchasing Commission. He will return to England to become deputy-president of the Federation of British Industries.

JOHN WENDELL BAILEY, professor of biology in the University of Richmond, Va., has been granted leave of absence to enter the Army. He will serve as Major in the Specialists Corps. He left for Fort Custer, Mich., on December 26.

REAR ADMIRAL LUTHER SHELDON, JR., assistant chief of the Bureau of Medicine and Surgery, recently returned to Washington after a tour of four months to make observations of medical facilities in the United Kingdom, North Africa, Sicily, West Africa, Brazil and the West Indies. He reported, according to the *Journal* of the American Medical Association, that "existing medical facilities, and those which are now in the process of completion, will be entirely adequate to meet any contingency."

AMONG the faculty of Yenching University, Peking, recently repatriated from the North China Internment Camp, in Japanese-occupied China, were the following: Dr. Wm. H. Adolph, professor of biochemistry; Dr. Alice M. Boring, professor of biology; Dr. Martha M. Kramer, professor of nutrition; Dr. Earl O. Wilson, professor of industrial chemistry, and Dr. Stanley D. Wilson, professor of organic chemistry.

DR. KARL PAUL LINK, professor of biochemistry of the Wisconsin Agricultural Experiment Station, will deliver the fourth Harvey Society Lecture of the

current series at the New York Academy of Medicine on January 20. Dr. Link will speak on "The Anticoagulant from Spoiled Sweet Clover Hay."

DR. WALTER SYMMINGTON MACLAY, head of the Mill Hill Emergency Hospital, London, recently described the work of the Mill Hill Relocation Center to the staff and students of the Medical Branch of the University of Texas at Galveston. Army psychiatrists from camps in Texas also atended. Dr. Maclay lectured on the rehabilitation methods used and showed a motion picture of the center in operation.

AT the five hundred and forty-second regular meeting on January 6 of the Entomological Society of Washington the presidential address was delivered by Dr. R. W. Harned. The program was as follows: "Medical Entomology in Wartime," by F. C. Bishopp; "Agricultural Entomology in Wartime," by S. A. Rohwer, and "Extension Entomology," by M. P. Jones.

AS already announced in SCIENCE, the American Physical Society, the American Association of Physics Teachers and the Electron Microscope Society of America will meet at Columbia University on January 14 and 15. At this meeting there will be a joint symposium on Training Programs for Army and Navy Personnel in the Field of Physics; the retiring presidential address of President A. W. Hull, of the Physical Society; the Richtmyer Lecture and the presentation of the Oersted Medal of the Physics Teachers; thirty invited papers of the Electron Microscope Society and a number of contributed papers.

IN accordance with the recent decision of the council the next meeting of the Society of American Bacteriologists will be held on May 3, 4 and 5, at the Hotel Pennsylvania, New York City. To aid in the national transportation problem, groups which are distant from New York City will be urged to send representatives who will attend the sessions and report to their groups. The scientific program will feature contributed papers and panel discussions on wartime problems and recent research in the various fields of bacteriology and immunology. Inquiries relating to the program should be addressed to Dr. L. S. McClung, Indiana University, Bloomington, who has been appointed chairman of the program committee. Abstracts of papers contributed by members must be received on or before February 14.

THROUGH the Ophthalmologic Section of the National Research Council, at the request of Sir W. Stewart Duke-Elder; Williamson-Noble of Great Britain; Lieutenant Colonel Derrick Vail, the consulting ophthalmologist to the American Expeditionary Force, and a number of other prominent American ophthalmologists, it has been decided to produce a work of two or more volumes covering a review of the literature of ophthalmology during the war years. The first volume will cover the period starting with the beginning of the war in 1940 until January 1. The next volume will continue until the time after the cessation of hostilities when there will be a free exchange of literature. Dr. Meyer Wiener, of Coronado, Calif., will appreciate the receipt of works for review in these volumes on, or pertaining to, ophthalmology, or of interest to the ophthalmologist.

DISCUSSION

THE ORIGIN OF LANGUAGE

IT is reported that Dr. E. L. Thorndike has recently published in SCIENCE his new theory of the origin of human speech. Unfortunately, under present conditions, scientific journals from overseas are difficult to obtain in England, but it is stated that, according to the new theory, speech arose from the "babbling" of primitive men and that meanings became attached to the individual sounds by "luck"; also that the various unrelated languages of mankind were all developed in the same way.

How can this theory (if correctly reported) account for the fact that many simple sounds are found to bear closely related meanings in nearly all the language groups, or the fact that, when a single sound is found to bear many different meanings (in the same language), these various meanings are found, in many instances, to be related to one another? The relation, in this case, is that they represent different natural ways of construing the same hand- (or mouth-) gesture.

Thus, the sound (or word) *ku* is the result of a sudden release of a tongue-to-throat closure, formed far back in the mouth, and a projection of the rounded lips—so as to form an elongated tube through which the voice flows. According to the gesture theory, this mouth gesture would be related to an originating hand-gesture from which the mouth-gesture was derived by unconscious sympathy of movement between man's hands and his mouth. The originating hand-gesture, in this case, might be one in which the two slightly cupped palms were held together, pointing forward, with the balls of the two thumbs touching (so as to form a closure), and the two hands were then moved suddenly forward.

This sign and the related mouth-gesture which produces the sound *ku* (or the closely allied sounds *gu* or *hu* or *xu*—where *x* stands for the German *ch* in *ach*) might be expected to bear any of the following panto-

mimic meanings: To project (*e.g.*, as in shooting with a blow-pipe); to move or push forward—or flow or pour—or even to push *back* something in the way, or something coming towards the signer; to reach or point forward; to be elongated or extended horizontally; to enclose, a long hollow or enclosure; to be empty (*i.e.*, considering the function of the cupped hands, or the walls of the mouth cavity, as containers); to be full (*i.e.*, considering the volume enclosed by the hands or mouth as containing walls).

It will be seen that, from the sign language aspect, the same hand-gesture or mouth-gesture may be expected to bear many different meanings, and that some of these may be direct opposites!

As a test of the gesture theory, a study was made of the various underlying meanings of 37 archaic Chinese words beginning with *ku, kü, yu* and *xu*[1] and of 51 Bohemian words beginning with *ku*[2]. The results may be summarized as follows. In archaic Chinese, the various underlying meanings were found to be related to the following interpretations of the originating mouth-gestures:

Interpretation	Number of instances
To flow (as through a tube), pour out	18
To project, point towards	15
Hollow	16
Empty	8
Enclosure	9
Extended hand (or hands)—offering or receiving money	4
Tube	4
Elongated in time (antiquity)	3
Elongated hollow (*cf.* English Coombe)	3
Projecting and rounded	3
Forward motion	2
Lying flat (horizontal)	1
Repelling	1
Onomatopoeic (?)	1
Of doubtful gestural significance	6

In Bohemian the symbolism was not so imaginative as in archaic Chinese. There were no examples of the interpretations "empty," "tubular," "elongated in time" or "elongated hollow," "lying flat" or "repelling," as found in archaic Chinese. On the other hand, there were examples of all the 7 remaining types, and two cases of onomatopoeia. The numbers in parentheses refer to the number of instances. Thus, "sing (choir)" (1), eject (2) are comparable to archaic Chinese "pour" or "flow"; "project up" (3), "point" (2), "sight" (1), "bundle" (1) are comparable to "project," "point upwards." The Bohemian word for "bundle"—*kukure-se*—may be compared with Japanese *kukuri* (sheaf of corn), the *ku* gesture being reduplicated to indicate a plurality of projecting elements forming the bundle or sheaf. The remaining interpretations include "hollow" (7), "enclosure" (1), to which must be added "grasp" (1), "heap or lump" (2), "offering or taking money" (1), "projecting and rounded" (6) and "forward motion" (4). There were 9 meanings of which the gestural origin was not recognizable.

It will be seen, therefore, that over 50 per cent. of the Chinese underlying meanings of words beginning with *ku, kü, yu* and *xu* are found in connection with words beginning with the similar mouth gesture (*ku*) in Bohemian speech. Such a correlation could surely not occur if the meaning of the words were due to chance.

The gesture theory was put to the test by the late Dr. R. R. Marett, D.Sc., F.B.A., Rector of Exeter College, Oxford, in 1929, when he challenged the present writer to "divine the correct interpretation" of a number of words in an unknown language by a study of their originating mouth gestures. A list of words (with their phonetic values only) was supplied by Professor Soothill (professor of Chinese at the University of Oxford) and the first 10 of these were studied by the present writer, from the point of view of the mouth gestures which produced them. They each yielded about 10 meanings. This list of "divined interpretations" was sent to Professor Soothill, who, in return, sent his list of the principal meanings of the selected words.

The two lists were then submitted to Dr. Marett, who recorded his conclusions in a Preface which he afterwards wrote to the present writer's little book, "This English" (Kegan Paul, London, 1935). He there says: "Sir Richard Paget registered over 50 per cent. of hits that were more or less on the target, some of them undoubted bulls." Dr. Marett himself had estimated the chances of a correct interpretation, by luck, at one in the hundred.

Both Dr. Marett and Professor Soothill are now dead, but Dr. Marett informed the present writer (in October, 1942) that Professor Soothill had also been satisfied that "there was something in the method" and that he also had confirmed the success of the experiment.

R. A. S. PAGET

[1] "Analytic Dictionary of Chinese," B. Karlgren, Paris, 1923.

[2] "Slovník Česko-Anglický Sepsal," Karel Jonáš, Chicago, 1890.

ACTION OF CLARASE UPON PENICILLIN

IN a recent issue of SCIENCE[1] there appeared an article by the writer entitled "Sterility Test for Penicillin." Since the statement was made in a footnote that additional studies would be published on this subject, numerous inquiries have been made as to when this material would appear in print. Inasmuch

[1] SCIENCE, 98: 413, November 5, 1943.

as some time will necessarily elapse between submission of the article for publication and its appearance, the present note is intended to give preliminary information as to the mechanism of action of the Clarase and Taka-Diastase preparations upon penicillin reported previously.

Other diastatic enzyme systems than those of Clarase and Taka-Diastase used in our preliminary studies on penicillin, although derived also from the fungus, *Aspergillus oryzae,* failed completely to show evidence of antipenicillin activity. Subsequent studies revealed that the preparations active against the antibiotic agent contained, in addition to diastase or amylase, certain water-soluble, filtrable substances, which are of bacterial origin and which are responsible in part, if not entirely, for penicillin inactivation. Broth filtrates of pure cultures of many of the organisms isolated from the active enzyme preparations will neutralize the effects of penicillin. These bacteria have been identified as belonging to the gram-positive, spore-forming *B. subtilis* and related groups of organisms.

Therefore, the demonstrated power of Clarase and Taka-Diastase to inactivate penicillin in the sterility test is due to bacterial end products which these preparations contain.

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THE IDENTITY OF CLAVACIN WITH PATULIN

WAKSMAN, Horning and Spencer[1] investigated the antibiotic agent produced by *Aspergillus clavatus* (No. 129) and proposed the name clavacin for this substance. Some time ago we began a study of the production, isolation and chemical properties of clavacin. Dr. Waksman kindly supplied one of us (H.W.A.) with *Aspergillus clavatus* (No. 129) which was grown on a Czapek-Dox medium modified as recommended by Waksman. The active material was extracted from the mold culture with ether. The ether solution was evaporated, leaving a brown gum from which the clavacin was extracted with a small volume of water. The aqueous solution was re-extracted with ether and the clavacin was obtained either by direct crystallization from the concentrated ether solution or after a preliminary purification over a silica gel column. The column was developed with moist ether which removed colored impurities first and then the clavacin. The crude material was readily purified by recrystallization from ether. The following data concerning the pure substance have been obtained: Melting point, 109–10° C; empirical formula, $C_7H_6O_4$; molecular weight (cryoscopic in benzophenone) 151, 157; $C_7H_6O_4$ requires 154); semicarbazone, darkens at 200°, decomposes at 290° C; 2,4-dinitrophenylhydrazone, darkens above 190°, decomposes about 300° C; lactone group indicated by slow reaction with alkali; saponification number 69, 71 (evidently molecule cleaved); Zerciwitinoff determination (in *n*-butyl ether) shows slightly less than one active hydrogen per mole; esterification by the acetic anhydride-pyridine method shows one hydroxyl per molecule. The substance is a neutral compound, darkens and loses activity in the presence of alkali, readily decolorizes alkaline permanganate, does not react with aqueous ferric chloride or Schiff's reagent, and is optically inactive.

At this point in our studies a publication by Raistrick and coworkers[2] appeared describing the substance patulin, an antibacterial agent produced by *Penicillium patulum* Bainier. Patulin has the same physical and chemical properties as clavacin. The 2,4-dinitrophenylhydrazones behave in the same way on heating. In order to extend the comparison the acetyl derivative and phenylhydrazone of clavacin were prepared. They melted at the same temperatures (116–117° and 151–152° C, respectively) as the corresponding derivatives of patulin. These results establish beyond question that patulin and clavacin are identical. The fact that both an *Aspergillus* and a *Penicillium* mold produce the same antibiotic substance and in about the same amount is sufficiently unusual to warrant publication of a brief note at this time. The details will be reported later.

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[1] Waksman, Horning and Spencer, *Jour. Bact.*, 45: 233, 1943.

[2] Raistrick, Birkinshaw, Bracken and Michael, *Lancet*, 245: Part II, 683, 1943.

SCIENTIFIC BOOKS

UNDER A LUCKY STAR

Under a Lucky Star. A Lifetime of Adventure. By ROY CHAPMAN ANDREWS. 300 pp. The Viking Press. New York. 1943.

THE title of this book would seem to imply that fortunate circumstances were the making of Roy Chapman Andrews. But I think nearly all readers, nearly all those who know Andrews and his work will

feel that the star might have shone for them in vain. The real lucky star was internal rather than external, the extraordinary character of the man, so tenacious of purpose, so skilled in carrying out his plans, so convincing to those who came in contact with him. I have a lively recollection of the occasion when he lectured at the University of Colorado. He had plenty of excellent pictures to show us, but he talked for two hours, and when he stopped I think there were few in the audience who would not have been glad to have him continue. I think it was the best popular scientific lecture I ever heard, and, lecturing as he did all over the country, he not only raised money for his next expedition, but sowed seed in the minds of thousands of listeners, seed which may yet produce a crop of scientific discoveries.

His earlier work, on whales and porpoises, tested his strength of purpose. He says:

> In thinking back over a somewhat adventurous life, my considered opinion is that nothing I have ever done required more unadulterated guts than going out on those tossing, twisting whaling vessels with the certain knowledge that I would suffer the tortures of the damned. Often I was so weak that I lay on the deck behind the harpoon gun like a dead thing and only when one of the sailors lifted me to my feet and hooked my arm about a stay could I work the camera and take my notes.

Later in life he got over susceptibility to seasickness, but this was after he had finished his work on the *Cetacea*.

Very interesting is his description of the Japanese in earlier times:

> My life in Japan, thirty-three years ago, might have been lived in a different country and with people of a different race, judging by the present-day Japanese. Seemingly the people I knew, and liked, have no relation whatever to the inhuman creatures we are fighting in this war of horror. . . . The everyday Japanese was a likable person, simple, full of *joie de vivre* and the worship of beauty. . . . I watched them change year by year with amazing rapidity, as they assimilated more and more Germanic ideas and *Kultur*. I saw them lose much of their courtesy and kindliness, their simplicity and charm. Each time I returned to Japan, there was less that was admirable and more of those characteristics which stamp the Japanese of to-day with the infamy of treachery and inhuman cruelty.

I can say that only twenty years ago, when in Japan, I was treated kindly and found much to admire. One may only hope that in years to come the virtues the Japanese had, they may regain, and once more contribute to the good of the world, in their own unique fashion.

The fossil-hunting expeditions to Central Asia have been so often described and illustrated in print that there is no need to review them here. But we must call attention to Andrews' plans or ideals for the future—a future he may not live to see. He believes that when the war is ended we shall see a new era of intensive exploration. Every part of the earth will be visited, but most important is Central Asia—Mongolia, southern Siberia, Chinese and Russian Turkestan and Tibet. "There is no other region on earth which will yield such important results in every branch of natural science. . . . The scientific attack must be made systematically like the campaign of an army to insure best results. It must be international."

Any one who reads the accounts of the Gobi expeditions will realize that, important as the results were, they represent only a minute fraction of what is to be found in that vast region. In the future we may expect that these regions will be opened up and, as in the case of Central Africa, will be easily reached with no great expense to the explorers. It will no longer be necessary to appeal to the millionaires, if any such survive in those days.

Andrews has written six books, but this is an autobiography, and I venture to suggest that it should be made over in several respects, to be more worthy of its theme. I should like to see it illustrated, with portraits of the author and his most distinguished colleagues, and figures of some of the more interesting fossils discovered, and of the scenery of the Gobi. I would leave out the chapters on organized vice in Japan and China, and insert an account of vertebrate paleontology in Asia, showing the work of the Andrews expeditions in relation to that of other workers, and thus bring out its importance as part of the progress of science. Thus, in the account of *Baluchitherium*, nothing is said of the gigantic skeleton which I saw (and Andrew must have seen) in the museum at Leningrad. We are told that Andrews was intimate with Dr. Davidson Black, who was "studying the remains of the 'Peking Man,' a primitive human discovered in the Western Hills." Nothing more, nothing to show that while Andrews was searching the Gobi for primitive man (where he will doubtless eventually be found), Black had obtained the very primitive *Sinanthropus* not far from Peking.

Some revision and amplification are needed. For example, we still see reported the fossil butterflies found in the Gobi. This was an excusable error made in the field, but long ago these specimens were studied, and reported on, with illustrations, in the publications of the American Museum. They are gigantic mayflies.

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MOMENTS

The Problem of Moments. By J. A. SHOHAT and J. D. TAMARKIN. xiv + 140 pp. American Mathematical Society.

THIS slim volume is the first in a series of "Mathematical Surveys," sponsored and published by the American Mathematical Society. And a good beginning it is. The authors have deftly assembled a wealth of results, mostly of somewhat specialized nature, and yet merging into general concepts.

The problem of moments, though rather special in its inception, was productive of the powerful concept of the Stieltjes integral and, in some measure, of the concept of an orthogonal system. In this respect, in the field of analysis it is second only to the problem of Fourier series which produced Cantor's set theory and Riemann's integral, and, to some extent, also Lebesgue's integral.

The authors are aware of this role of the moment problem but in outlining gentralities they are brief and to the point. They succeed in introducing the different variants of the moment problem as just so many problems in representing positive functionals on partially ordered function spaces, without mentioning the latter concept by name. Or again, they derive all pertinent facts about quasi-analytic functions as far as their problem is concerned without featuring the topic as such. However in expounding the connection with continued fractions they are emphatic in suggesting that, in substance, the problem is one of characterizing anlytic functions of a complex variable whose imaginary part is positive in a half-plane. No account of such functions is complete without reference to Hermitian operators in Hilbert space, but the authors omit the reference for lack of space. The authors' heart is obviously in "classical" analysis, and so they include a chapter on approximate quadrature instead.

This and similar books will be a good reminder to younger mathematicians that "modern" mathematics is not all abstract spaces, group theory and such like.

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SPECIAL ARTICLES

THE EFFECT OF pH ON THE AVAILABILITY OF p-AMINOBENZOIC ACID TO NEUROSPORA CRASSA[1]

SOME sulfonamides become more active as the pH is increased, this enhanced activity paralleling the ionization of the sulfonamide.[2] However, Schmelkes[3] has pointed out that sulfonamides which are so substituted as to preclude ionization also increase in activity as the pH is increased, a fact which is unexplained by the ionic theory of sulfonamide action. Since the undissociable sulfonamides supposedly do not undergo any change in the pH range involved, such an effect might be ascribed in part to decreased activity of *p*-aminobenzoic acid. The work of Brueckner[4] with *Staph. aureus* suggests that *p*-aminobenzoic acid, as well as the ionizable sulfonamides change in effectiveness as the pH is altered. But it is difficult to divorce the effect of pH on the sulfonamide from that on *p*-aminobenzoic acid in such bacterial inhibition experiments involving both of these compounds. The *Neurospora crassa* mutant of Tatum and Beadle was considered a more suitable test organism because it requires an exogenous supply of *p*-aminobenzoic acid, thus affording an opportunity to study the action of pH on the effectiveness of this substance alone.

The fungus was grown in a nutrient solution consisting of 25 g dextrose, 1 g potassium dihydrogen phosphate, 0.5 g magnesium sulfate, 2 g casein hydrolysate, 1.32 g Norit-purified fumaric acid, 0.2 ppm each of iron and zinc, 0.1 ppm manganese, 1 microgram biotin and 1,000 ml distilled water. Enough sodium hydroxide was added to adjust the pH to the various levels. Twenty-five ml of this solution was placed in 250 ml flasks, autoclaved, inoculated with a loopful of a suspension of germinating spores and incubated for 72 hours at 25° C. The mycelium was harvested, dried at 85° C. for 24 hours, and weighed.

TABLE 1

THE EFFECT OF PH ON THE GROWTH OF *Neurospora crassa* MUTANT IN THE PRESENCE OF VARIOUS AMOUNTS OF *p*-AMINOBENZOIC ACID

Micrograms of *p*-aminobenzoic acid per 25 ml of nutrient solution	The average weight in mgs of dry mycelium per flask			
	pH 4.0	pH 5.0	pH 6.0	pH 7.0
0.0	0.0	0.0	0.0	0.0
0.00625	8	..	..	..
0.0125	8	3	..	..
0.025	15	8	..	..
0.05	28	20	3	..
0.1	33	37	8	4
0.2	36	23	16	4
0.4	35	27	18	5
0.8	..	29	38	42
1.6	..	..	34	52
3.2	..	..	..	59

Table 1 gives the different treatments and the results.

The foregoing picture remained essentially the same

[1] Published with the approval of the Director of the West Virginia Agricultural Experiment Station as Scientific Paper No. 314.

[2] F. C. Schmelkes, O. Wyss, H. C. Marks, B. J. Ludwig and F. B. Strandskov, *Proc. Soc. Exp. Biol. and Med.*, 50: 145, 1942.

[3] F. C. Schmelkes, *Jour. Bact.*, 45: 67, 1943.

[4] A. H. Brueckner, *Yale Jour. Biol. and Med.*, 15: 813, 1943.

when the agar medium of Tatum and Beadle[5] was used and the rate of growth was determined by measuring the diameter of the colonies. It should be stated that this fungus is variable, the amount of growth fluctuating over a wide range under apparently identical conditions. Nevertheless, the fundamental principle of its behavior remains the same, namely, that the effectiveness of *p*-aminobenzoic acid as a growth factor decreases with the increase in pH.

An opposite pH effect was observed by Stokes, Foster and Woodward[6] with a pyridoxin-requiring mutant of *Neurospora sitophila*. These investigators found that under certain conditions of nitrogen nutrition the fungus could synthesize pyridoxine at a rate necessary for normal growth if the pH remained above 6.2. However, in a medium containing no *p*-aminobenzoic acid the pH exerted no controlling effect on the *Neurospora crassa* mutant used in our work. In the presence of the vitamin the fungus attains maximum growth within a few days, whereas in its absence no growth will occur during that time. This failure to grow may continue for two or three weeks, but eventually, and then within only a few days, a rich growth will ensue regardless of the pH value. From the weight of the mycelium produced in such cultures, as well as from microbiological assay of the culture filtrate, it is evident that through some adaptive process the organism develops a latent ability to synthesize *p*-aminobenzoic acid during the prolonged incubation period. The fact that this synthesis and the growth resulting from it are not fundamentally influenced by the pH of the culture medium indicates that the pH effects observed in the early growth must be ascribed to changes in the effectiveness of the *p*-aminobenzoic acid.

Since *p*-aminobenzoic acid has a dissociation constant of about 2×10^{-5}, at pH 4.8 it exists in solution as equal amounts of molecules and ions. At pH 5.8 the molecular form decreases from 50 to 10 per cent. and above that value the portion present as the molecule drops almost tenfold with each unit rise in pH. Therefore, the efficiency of the vitamin in the nutrition of this organism appears to be a function of the molecular form rather than of the ion.

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[5] E. L. Tatum and G. W. Beadle, *Proc. Nat. Acad. Sci.*, 28: 234, 1942.

[6] J. L. Stokes, J. W. Foster and C. R. Woodward, Jr., *Arch. Biochem.*, 2: 235, 1943.

RAPID AND STERILIZING EFFECT OF PENICILLIN SODIUM IN EXPERIMENTAL RELAPSING FEVER INFECTIONS AND ITS INEFFECTIVENESS IN THE TREATMENT OF TRYPANOSOMIASIS (TRYPANOSOMA LEWISI) AND TOXOPLASMOSIS[1, 2]

THE following preliminary report deals with the results obtained with penicillin sodium therapy in the following experimental infections: (1) trypanosomiasis, *T. lewisi,* in laboratory rats of a Wistar strain believed to be free from *Haemobartonella muris;* (2) toxoplasmosis, and (3) relapsing fever in Swiss mice. The penicillin sodium used in these experiments was kindly furnished by Dr. Chester Keefer.

(1) *Trypanosomiasis.* Six rats weighing about 70 grams each were used in testing the therapeutic value of penicillin sodium in trypanosomiasis. Treatment was started on 4 of the rats 6 days after their inoculation with a dilute suspension of blood containing adult trypanosomes. The infections in the 2 untreated rats served as controls. The routine therapy covered a period of 48 hours and consisted of the subcutaneous injection of 2,000 Oxford units of penicillin sodium dissolved in 1 cc distilled water every 3 hours, night and day, for 2 rats, and intraperitoneal injections of the drug in a similar manner for the other 2 rats. The total dose received by each of the 4 rats was 32,000 units, or 429,000 units per kilogram. Parasite counts were made 24 hours after the initial dose and daily thereafter for 5 days. No significant difference was noted between the counts for the treated and untreated animals. All infections ran a typical course. The trypanosomes in the blood of the treated animals appeared active, unharmed, and infected other rats, producing again typical infections.

(2) *Toxoplasmosis.* In the toxoplasma experiments the mice were infected by the intraperitoneal inoculation of large doses of a strain of *Toxoplasma* highly pathogenic for mice. Sixteen mice were infected.

Treatment of lot I, consisting of 4 mice, was started the 5th day after infection; each received 9,000 units, 500 units intraperitoneally in 0.5 cc saline every 3 hours. The treatment of lot II, also consisting of 4 mice, was started on the 9th day after infection. Each mouse received 500 units intraperitoneally in 0.5 cc saline to make a total dosage ranging from 6,500 to

[1] From the Department of Comparative Pathology and Tropical Medicine, Schools of Medicine and Public Health, Harvard University.

[2] A preliminary report.

9,000 units. The treated mice died in the same interval as the infected, untreated controls.

(3) Relapsing fever (*"S. novyi"* strain). Eleven mice were inoculated intraperitoneally with 0.25 cc heparinated pooled blood from five mice showing heavy infections with *S. novyi*. Twenty-four hours later the infections were moderately heavy and treatment of six of the mice was started with penicillin sodium. The remaining 5 mice served as controls. The treated mice received intraperitoneally 1,000 units in 1 cc saline for a first dose. Every 3 hours thereafter, for 48 hours, each animal received an additional 500 units of the drug. The total dose for each treated mouse was 9,000 units. The first effects of the drug were observed 6 hours after the first dose. At this time the infections had decreased in intensity to about one fortieth in the treated mice, whereas they increased about 50 per cent. in the untreated animals. At the end of 27 hours no spirochaetes were microscopically visible in the treated mice, whereas in the untreated animals they averaged 140 in a single oil immersion field. Sixty hours after treatment was started, 2 of the apparently cured mice were sacrificed. The citrated heart blood of each mouse was inoculated intraperitoneally into two new mice. No infections resulted.

In a second experiment a relapsing fever mouse, sacrificed after receiving 4,000 units in 19 hours, was found to be a carrier, although no spirochaetes were found in a thick drop of its blood.

From the results of these preliminary experiments, it is evident that penicillin sodium, in the very large doses employed, was inactive against *Trypanosoma lewisi* and *Toxoplasma*, but was spectacularly effective in the treatment of relapsing fever.

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HEPATIC DYSFUNCTION IN MALARIA

EVERY student of the subject is aware that enlargement and tenderness of the liver and even jaundice may occur in the various forms of malaria. Nevertheless, relatively little attention has been given to the possibility that hepatic dysfunction and its associated derangements in metabolism can exist in this disease. Slatineau and Sibi,[1] and Phocas[2] did note that some degree of transitory hepatic insufficiency exists in nearly all cases, but their data has not received general acceptance. More recently Kopp and Solomon[3] studied the influence of induced tertian malaria on the liver function of nine patients under treatment for general paresis. They noted a transient disturbance in liver function which usually cleared up within three to six weeks after the termination of the malaria.

With the increasing incidence of malaria consequent to the war, it became important to establish further the probability that an associated liver dysfunction is more frequent than is generally acknowledged. Towards this end, the status of the function of the liver was studied in a series of malaria patients by means of various tests and constituents of the blood. The present preliminary report deals with two cases without a previous history of malaria before the present attack, six with recurrent malaria and a history dating back as long as six months to two years, and two patients with a definite history but no evidence of malaria at the time of study.

The preliminary pertinent data obtained at various intervals during the patients' hospitalization are summarized in Table 1 and reveal that every patient with malaria had an abnormal cephalin cholesterol flocculation test. The majority of the patients also demonstrated an increased sedimentation rate, an anemia, a high serum globulin and, in fewer instances, a slightly increased icteric index. For purposes of comparison another flocculation test, the Kahn test for syphilis, was performed at the same time as the cephalin cholesterol flocculation test. In every instance a negative result was obtained.

Many studies with the cephalin cholesterol test have established that this procedure is an excellent, sensitive measure of hepatic damage. The data summarized previously, therefore, may be interpreted as indicating that in nearly every case of malaria some degree of liver damage may exist. Since the initial test was performed in several instances before any therapy was instituted, it is probable that neither atabrine nor quinine are factors in the production of the hepatic damage.

The presence of liver damage in malaria necessitates revision of modern treatment, since not only is it necessary to administer the specific drugs aimed at the elimination of the plasmodia, but it is necessary also to institute measures which may result in a restitution of the liver to normal. Such measures are the administration of high carbohydrate, high protein, high vitamin diets and not the administration of "only fluids during the course of the fever," as is advocated by some of the leading students of malaria.

The efficacy of a diet aimed at improving the status of the liver is suggested by the fact that patients thus treated may show a rapid disappearance of the positive cephalin cholesterol flocculation test, while patients not treated in this manner show a positive floc-

[1] A. Slatineau and M. Sibi, *Arch. Roumanes de Path. Exper. et Microbiol.*, 7: 529, 1934.

[2] E. Phocas, *Rev. Med. et Hygiene Tropicales*, 29: 246, 1937.

[3] I. Kopp and H. C. Solomon, *Am. Jour. Med. Sci.*, 205: 90, 1943.

TABLE 1
HEPATIC FUNCTION IN MALARIA

Name	Plasmodium	History	R B C	Reticulocytes	Sedimentation rate	Total cholesterol	Blood sugar	Icterus Index	Serum albumin	Serum globulin	Kahn	Bromsulfalein	Cephalin-cholesterol
			M/cmm	/100	mm/hr	mgm/100	mgm/100		gm/100	gm/100		%/45 min	
PL	Falciparum	Acute	2.66	..	8.1	...	...	18	5.5	1.5	Neg.	..	+++
JA	0	Chronic (?)	3.70	..	31.5	195	69	6	..	..	Neg.	0	++
HB	Vivax	Acute	3.80	0.5	51	110	111	11	4.0	3.0	Neg.	0	++++
HL	0	Chronic (?)	4.30	0.1	14	280	88	5	3.7	2.5	Neg.	..	++
OW	Vivax	Recurrent	4.11	..	...	230	79	18	4.0	2.0	Neg.	..	++
CH	Falciparum	"	4.33	0.5	...	225	...	10	4.5	2.2	Neg.	..	+++
AMcC	Vivax	"	3.77	1.4	...	155	...	11	4.5	2.9	Neg.	..	++++
IVS	0	"	4.17	0.4	29	205	91	5	4.9	3.1	Neg.	0	++
CBR	Vivax	"	4.4	1.9	30	120	64	4	4.0	3.3	Neg.	12	++++
GER	Vivax	"	4.7	0.9	10	190	101	9	4.3	2.9	Neg.	0	+++

culation reaction as long as one year after the last attack.

Further and more extensive studies as to the status of the liver in malaria are imperative. It may be important also, to determine the relationship of liver damage to the incidence of recurrences and the development of immunity. Such studies will form the basis of a more complete report.

CONCLUSIONS

(1) The cephalin cholesterol flocculation test was positive in all ten cases of malaria of varying duration. This is interpreted as indicative of the presence of hepatic damage.

(2) It is proposed that in addition to the specific drugs, a high carbohydrate, high protein and high vitamin diet be administered early in the therapeutic régime.

Major Mirsky is indebted to Dr. David Klein, The Wilson Company, Chicago, Ill., for generous supplies of the cephalin-cholesterol mixture.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

PENICILLIN ASSAY

Outline of Four-Hour Turbidimetric Method

THE following method of determining the potency of penicillin solutions is advantageous in that it is conveniently set up and makes possible the turbidimetric reading of the test in the same test-tubes in which the culture is grown. In these respects it is believed to be more practical than turbidimetric methods proposed by others.[1]

Procedure: Into a duplicate series of nine sterile, plugged and standardized test-tubes (18 × 140 mm) place aseptically, in order, the amounts of sterile Veal-Glucose Broth[2] noted in column 4 of Table 1. These

TABLE 1

Units of penicillin (standard)	Penicillin Sol. added		Amount of broth in tubes	Optical density		
	Strength	cc		Standard		Unknown
				No. 1	No. 2	
None	..	..	9.6	.33	.32	.30
0.05	0.5 per cc	0.1	9.5	.30	.29	.29
0.10	"	0.2	9.4	.27	.26	.26
0.15	"	0.3	9.3	.22	.22	.23
0.20	"	0.4	9.2	.19	.20	.21
0.25	"	0.5	9.1	.17	.18	.19
0.30	"	0.6	9.0	.15	.15	.17
0.35	"	0.7	8.9	.15	.15	.16
0.35	"	0.7	9.3	.00	.00	.00

[1] J. W. Foster, *Jour. Biol. Chem.*, 144: 285, 1942; J. W. Foster and H. B. Woodruff, *Jour. Bact.*, 46: 196, 1943; J. W. Foster and B. L. Wilker, *Jour. Bact.*, 46: 387, 1943.

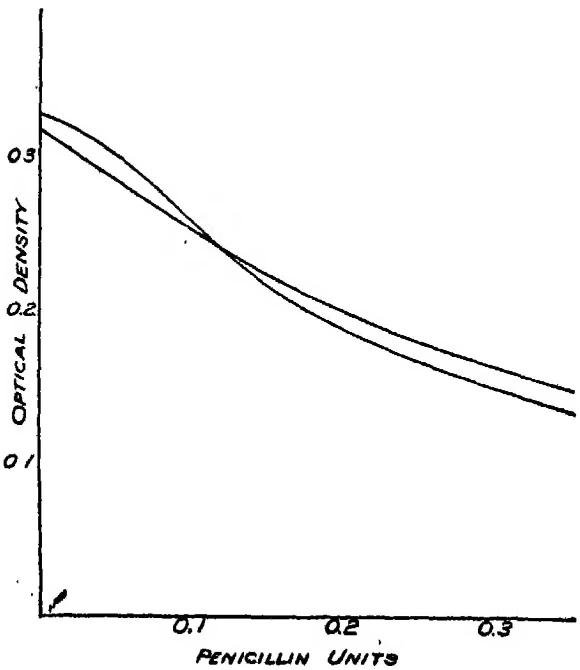
[2] Veal-Glucose Broth: 1. To 500 gm ground veal from suckling calves 6–8 weeks old, which have not been slaughtered more than one week, add 1,000 cc of distilled water and soak overnight, in refrigerator. 2. Boil 15 minutes, strain through cheesecloth and make up to original volume of water. 3. Sterilize at 15 pounds pressure for 45 minutes. For convenience, a quantity of this base-infusion can be made at one time and stored. 4. Filter sterile veal infusion prepared as above through wet, coarse filter paper. 5. Add Bacteriological Peptone (P.D. & Co.), 1 per cent.; Sodium Chloride (Diamond Crystal), 0.5 per cent.; Dextrose C.P., 0.1 per cent. 6. Heat to dissolve. 7. Adjust to final pH of 8.0 (8.6 at this point). 8. Heat at flowing steam for 15 minutes. 9. Filter through wet fine paper. 10. Fill as desired. 11. Sterilize at 15 pounds pressure for 20 minutes.

are for the standard which is run in duplicate. For each unknown solution to be assayed, prepare one additional row of nine tubes.

Prepare a solution containing 0.5 unit per cc of the penicillin standard in cold sterile distilled water and add to the broth tubes according to the amounts in column 3. From estimated values of units for the unknown samples, prepare a solution of each which contains an estimated 0.5 unit per cc. Add these solutions to their respective rows of tubes in the same manner as the standard. Place into each tube (except for the last which serves as a colorimetric and sterility control) 0.4 cc of an 18–20 hour culture of *Staphylococcus aureus* (National Institute of Health No. 209). The culture is prepared by inoculating a flask containing Veal-Glucose Broth from an agar slant. This resulting suspension, which is used as the inoculum, should have an optical density of about 0.4.

Place the tubes into an incubator or constant temperature water-bath at 37° C for 4 hours or until the optical density of the control tube reaches about 0.30 (0.27 to 0.34 has been found to be satisfactory). (A constant temperature water-bath has been found to give more consistent results and hence a smoother curve). At the end of the growing period immerse the tubes in cold water (about 10° C or less) to stop active growth of bacteria. After cooling, the tubes should be wiped dry and shaken thoroughly.

Measure the density of each tube by means of a photoelectric colorimeter[3] using a red filter. These



[3] Lumetron. Manufactured by Photovolt Corp., New York City.

values are recorded opposite their corresponding tubes, as may be seen in Table 1, a typical protocol.

The densities are plotted as the ordinates against penicillin units as the abscissae. A smooth curve is drawn through these points. This is done for each row of tubes representing the standard, thus giving two curves which correspond to the duplicate standard. A line is then drawn halfway between these two curves and serves as the average curve which is employed in the calculation of the number of units in the samples of unknown strengths. This calculation is explained in Table 2.

TABLE 2

A Units of penicillin in standard	Optical density of unknown	B Units of unknown (read from curve)	C Estimated units of unknown	Units of unknown $\frac{B}{A}$ C =
0.05	0.29	0.056	5000	5600*
0.10	0.26	0.096	"	4800
0.15	0.23	0.136	"	4500
0.20	0.21	0.168	"	4200
0.25	0.19	0.210	"	4200
0.30	0.17	0.260	"	4330
0.35	0.16	0.290	"	4150
				Av. = 4370

* Not used in calculation because 5600 is definitely out of range.

Values obtained by this method are characteristically in good agreement. Consecutive assays on two samples were 48300, 47600, 45300, 49400 and 1675, 1516, 1300, 1580, respectively. In five consecutive days the units per cc of one standard as calculated from the curve of its duplicate were 0.495; 0.52; 0.45; 0.52 and 0.49, respectively.

Appreciation is hereby expressed for the technical assistance given by Dr. J. M. Vandenbelt of this laboratory.

D. A. Joslyn

Research Laboratory,
Parke, Davis and Company,
Detroit, Michigan

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WHAT SCIENCE REQUIRES OF THE NEW WORLD[1]

By Professor ARTHUR H. COMPTON

UNIVERSITY OF CHICAGO

Fellow Americans:

PERMIT me to say a word first to the members and affiliates of the American Association for the Advancement of Science, whose number approaches a million.

Once more, because of the rigors of war, we have found it impossible to hold the annual meeting that has been our tradition for almost a century. My own colleagues, as typical members of our association, are this afternoon in their laboratories, engaged as devotedly as any member of the armed forces in the effort to preserve our country's freedom. Yet the world comes to us as representatives of science with searching questions. We must pause to give a considered answer. "This is a war of science and technology," they tell us. "Do the forces of freedom have the knowledge, skill and technical resources needed to bring victory?" "After the war is over how will science have changed our world?" The nation asks us, "What of the night, and what of the day that is to dawn?"

Unconditional answers to these questions can not be given. Yet it is possible to say something about the present balance of scientific power and to point the direction in which science makes it necessary for the world to move.

I have accordingly chosen as my subject for to-day, "What Science Requires of the New World." For science is not only a servant; it also gives orders. There is a legend that Daedalus, the Greek hero who first learned how to work with steel, toiled long and hard with his forge and anvil to fashion a sword. This he presented to King Minas to replace his old one made of bronze. The citizens of Crete came to him in consternation. "This sword will not bring us happiness," they complained, "it will bring us strife."

[1] Address of the retiring president of the American Association for the Advancement of Science, January 1, 1944.

"It is not my purpose to make you happy," replied Daedalus. "I will make you great."

Science is the steel of Daedalus. His sword is the weapons we are fashioning with the aid of science. As his steel, so likewise science brings new social conflicts and changes in treasured traditions. But also like the steel of Daedalus, science is compelling man to follow the sure road to a greater destiny. Let us try to catch a glimpse of this new world that science bids us enter. Can we attain a stable peace? In the post-war world, what changes in our mode of life does science demand?

First, let us note that science affords real hope for a stable peace. We find ourselves in a world conflict with the mighty powers of science strengthening the arms of both contestants. "A hundred physicists in this war are worth a million soldiers." This oft-quoted statement was made by one of our leaders early in the struggle. Consideration of the military significance of radio, magnetic mines, methods of submarine detection and a variety of new weapons which the physicists have initiated or developed indicates that this estimate may not be greatly exaggerated. With equal justification, however, one might have singled out the vital contributions to the war effort made by research in chemistry, mathematics, immunology, aerodynamics or some other field of science and technology. We have learned that knowledge is strength, and that intensive scientific research is the only way of supplying certain types of knowledge that are essential to waging modern war.

The fact is that science and technology are now spending extraordinary efforts on supplying means of destruction and methods of protection against attack. At first it was our enemies who had the scientific advantage. This was because for a prolonged period the Axis powers had been making extensive scientific as well as military preparations for the war. There is evidence, however, that in most fields of military operations our technical advances are now coming more rapidly than are the enemy's. When added to our overall industrial advantage and our superiority in supply of materials and men, if this scientific advantage can also be maintained, there is little room for doubt of the success of our armies.

We do not discount our opponent's strength. We know the high quality and resourcefulness of his scientific and technical men. We accordingly expect reverses as well as successes. Yet the Allied Nations are in a superior position with regard not only to availability of materials, industrial capacity and numbers of fighting men, but also with regard to scientific and technical strength. Because we have this strength, and are determined to preserve our freedom, we may lay our plans for the future on the assumption of victory.

When peace has then been won, can the world be kept stable?

Let us assume that the United Nations have gained a complete victory. All indications are that the world will still be actively war-minded. However successful may be our armies and the efforts of the negotiators of peace, a great conflict such as the present war will leave many wrongs unrighted and large groups of people resentful at their fate and filled with fear and hatred toward their neighbors. Weapons of destruction are being developed of hitherto unheard-of power. No one can consider the armadas of mighty bombers, with flying range to reach any target, and the increasing amount of destructive bombs they carry, without fear of a yet more disastrous war to come. There will be a nation smarting under the restrictions placed upon it and ambitious for power. What will prevent it from welding these weapons into a war machine with which it will snatch the mastery of the world?

The only answer to this threat is preparedness and vigilance by the powers in control. Preparedness and vigilance have always been the price of continued peace. What science and technology have brought into the picture is a change in the type of precautions that must be taken. Improving the chance for stable peace is the increasing time and magnitude of the preparations required to wage successfully a modern war.

Consider what is needed to exploit the power of airplanes. Here is a weapon whose development and production strains the technical resources of the greatest nation. The same is true of the factories that would build tanks or the laboratories that would develop electronic devices superior to those of an ingenious and highly skilled enemy. It is one of the great safeguards of the stability of modern society that the weapons with which wars are now won are the product of cooperative research and manufacture on so large a scale that the effort can not be hid. If precautions to maintain peace are to be taken, we must assume the establishment of a world policing system with power to learn what nations are doing that may constitute hazards to the public safety, and determination to stop unlicensed building or accumulation of arms. The large scale of modern military preparations makes such policing much more practicable than was true before technology became the basis of military power.

But, we are asked, can not some new weapon be developed secretly on a small scale which is nevertheless so powerful that those who hold it will have the world at their mercy?

Here again the trends of modern science give us considerable assurance. More and more the major inventions and industrial developments are the result of the cooperative efforts of large groups of research

men. An idea may emerge in the mind of a lone inventor, but it passes through many hands before it is ready for use. Also, parallel developments by competing groups are the rule. It is rare indeed that a completed new industrial development catches the world by surprise. If this is true in industry, it is yet more unlikely that the balance of the world's military power will be upset by an idea kept secret from a vigilant enemy. To be of conclusive military significance not only must the idea be perfected; the new weapon must also be adapted to industrial production and be manufactured on a major scale. But such a development is difficult to hide. In spite of airplanes and radios, the world is still a big place, and a weapon that would conquer the world must be ready for widespread use. If we are alert we should know of any new military development of this kind before it has become a hazard to nations organized to protect the public safety.

One of the most necessary aspects of vigilance is the active cultivation of science. Not only is science the foundation for present military developments; it is also the means of opening up of new possibilities. It is an absolute "must" for a nation that would maintain its place in a warlike world that it shall keep its science in the front rank. The possibilities of present and new ideas of military import must be explored to be sure no competing nation will gain the advantage of being first in the field. Only by maintaining an active body of scientists can the foundation be laid for a strong military structure when it is required. Stability and peace in the new world thus can not be ensured unless the dominant world power keeps up a vigorous and continued growth of science.

Equally essential to military superiority is industrial strength, factories accustomed to doing large tasks rapidly, sources of raw materials and good communications. These are the tools that will make effective use of the ideas developed in the laboratories. Possession of large armies, navies and air forces are needed to start a war, but if the struggle is prolonged mere accumulation of such forces can not bring victory. Ultimate fighting power depends rather upon knowledge and facilities for building this knowledge rapidly into weapons as best fitted to changing conditions. Careful attention must thus be given to both the scientific and the technological foundation of military might.

The net result is that with the use of a world police force of a feasible size, it should be possible for a dominant governing body to maintain a stable peace in the new world that science builds. In spite of mighty new weapons that may tempt some ambitious leader to try again to snatch control of the world, the need for vast scientific and technical development to produce such weapons gives a stability adequate for a vigilant governing power to keep the peace.

So much for the *negative* side. We have seen that in the world that science is shaping an alert government should be able to prevent serious wars if only it will maintain the strong science and technology that are the basis of modern military strength. What now of the *positive* side?

Scientific men are becoming increasingly conscious of their social responsibilities. They begin to realize more clearly the tremendous human implications of the forces which their investigations are introducing. A parent is eager that his child shall contribute something worthwhile to society. So the scientist is eager that his science shall work for human welfare. He sees vast new possibilities for betterment of life, and he is impatient to see these possibilities become realities. More and more those concerned with science are endeavoring to ensure the wise use of the products of science.

But I am not concerned to-day with what we as members of the American Association for the Advancement of Science may *want* our sciences to do for humanity. I would call attention rather to those changes in society which growing science and technology make inevitable. I am not referring to new gadgets or improved standards of living, nor even to better health and longer life. These are the obvious and direct results of applied science. We know they will come as science continues its task, and they are welcome gifts, indeed. But I am thinking rather of the inescapable trends that follow the principles of evolution. Only those features of society can survive which adapt men to life under the conditions of growing science and technology.

There are three such features which I shall use as examples. These are (1) increasing cooperation, (2) better and more widespread training and education, and (3) rise of commonly accepted objectives toward which society will strive. Note that such changes mean growth to greater manhood. That science makes them inevitable was what Daedalus meant when he said his steel would make men great.

Finding ourselves then in a stable new world, how will the conditions of life be changed?

Perhaps the most significant change in the life built by science and technology will be the increased organization of people into larger groups concerned with performing common tasks. People will become yet more specialized, and consequently will be increasingly dependent upon each other.

H. G. Wells has called attention to a remarkable example of evolution, in which during the short period of a thousand generations an organism has been observed to change from an individualistic animal like a

cat to a social animal like a bee or ant. He refers, of course, to man, who twenty-five thousand years ago lived in caves with his loosely bound family, and now lives in vast communities in which each works for the group and depends upon the other for most of his means of living. Here is evolution in progress—social evolution, if you please—man becoming civilized.

My present interest in this process is that the chief forces bringing about the socialization of mankind have always been those of increasing knowledge and techniques, of which the characteristic present-day representatives are science and technology. For thousands of years each village has had its butcher and baker and candlestick maker, specialists in their trades who supply others with their wares. The scientific age has greatly increased this specialization. It is not enough now to be a chemist or an engineer; one becomes an organic chemist specializing on long chain esters, or an electrical engineer specializing on echoes of short electric waves. The nation needs this special knowledge, and supports the few who have it by the efforts of millions of others. In fact, the world itself is not too large a unit to support and use effectively the work of such specialists.

Were it not for technology, by which the work of each person is greatly multiplied through use of power machines and methods of mass production, the work of many highly specialized individuals could not be supported. Were it not for science, which has made possible such developments as steam engines, airplanes and the radio, there would be no markets of continental extent which absorb technology's mass production. Combining the specialization of science and the mass production of technology, a society is built of unparalleled richness and strength.

A noteworthy feature of this modern society is that its strength depends to an unprecedented extent upon the cooperation of its members. Since the specialist can live only through the help of others, cooperation is the corollary of specialization. We have learned that the automobile demands sobriety, and that congested life in a city requires careful attention to sanitation. Similarly, we are now learning that life in the world built by science and technology is possible only with widespread cooperation.

In the fight for survival by various forms of society one sees the evolutionary process operating in full force. During times of stress weaker societies are absorbed or replaced by stronger ones. Cooperation thus becomes essential to the survival of any social régime.

Effective means of securing cooperation accordingly becomes a major objective of political systems. Breakdown of cooperation in the ranks of the enemy becomes a most useful method of weakening an enemy in wartime. Replacing a monarchy with a democracy, introducing the military rule of fascist dictators, rallying a nation to support of a communistic state, all are examples of attempts to secure a more effective basis for cooperation in the common tasks of society.

The first essential in securing widespread cooperation is to develop a widespread desire of people to work together. Several methods of securing such will to cooperate are effective. The most certain is to present people with a common danger, such as attack by an enemy. It is this that has built a nation out of the Chinese people, and that has made the strength of our nation grow beyond our dreams during the present conflict. Another powerful method is to present the group with an inspiring objective. Thus Hitler calls to the Germans to make of themselves a master race, Lincoln challenges his countrymen to strive "that freedom shall not perish from the earth." With such an ideal men and women lose themselves in working for the common cause.

But also in the more prosaic periods of normal, peaceful life the cooperativeness of a community depends upon having common interests. If specialized science requires cooperation, cooperation in a society of free people requires the will to work for the common welfare. "Without vision the people perish" applies with tenfold force to the modern world. Whether this vision comes from the loyalty bred of a common danger, from political or economic expedience, from philosophical principles or from the inspiration of religious teaching, the will must be there. Otherwise the inhabitants of a specialized community can not obtain their needs without conflict, and the great advantages of technological society have turned into tragic liabilities. Science thus requires of the new world that its people shall want to work together for the common good.

Let us note further that the extent of the social unit in which this cooperation occurs is being increased rapidly by science. Typical of the forces working in the direction of expansion is the radio. Its music, stories and news are heard over large areas. The radio advertisements make possible the sale of products over a market of continental size. As a result the optimum size of a strong political or economic unit is rapidly growing. Eighty years ago our country was almost split asunder by divided interests. Now its continental size gives great advantages in both industry and government, and the divisive forces are lost amid the concern with mutual trade and the technical and military strength that comes because the country is big. Science itself is as extensive in its interests as the human race. So also is religion. Nations may try to make themselves

self-sufficient, but this is in the interest of security as opposed to an advantageous economy. Economic considerations alone would make trade extend freely throughout the globe.

The advantages of such global extensiveness are evident in the British empire, and to lesser extent in our own country. A phone call to a distant city brings at once the information needed to complete a design. Tools for an emergency repair are flown across the continent. An international misunderstanding is quickly cleared by flying a statesman ten thousand miles across the sea. Pictures and stories and songs representing the life of one people become familiar to all the world. Such are the forces with which science is drawing the world together into one great community. The fate of the world from here on is a common fate.

It is the American men and women of science who are pioneers in shaping this world community. In no other part of the world is life so dependent upon the products of science as among ourselves. This is clearly demonstrable in terms of the number of kilowatts or of radios or of tons of steel or gallons of gas or telephones per capita. People in other parts of the world look with dread to the time when their lives will be altered by technology. It will upset their ancient customs. Things long cherished will disappear and be replaced by things new and strange. We do not dread science and technology; it is natural to us as a part of our lives. Of necessity the world must look to America as the pioneer in finding how to live a satisfying life in a society based on science.

Amid the standardized products of mass production, how are the ultimate values of individual life to be attained? How can we best cultivate the spirit of mutual helpfulness so highly important for a satisfactory life in a technological régime? What type of education will fit citizens for a useful and satisfying life in such a world? We in America face these questions first and in their most acute form. We who represent American science are those who have perhaps had most first-hand experience in hunting for the answers. The world looks to us to point the way.

One thing we have already found is that technology and science place unprecedented value on education. The use of steam and electric power has decreased the need for common labor, while growing specialization has increased the need for those who coordinate our activities. Skilled labor, however, remains vital to American society for building and operating our machines, and is rewarded with shortened hours and higher pay. Business requires middlemen to handle its varied commerce. Vastly increased numbers of professional men and women have been absorbed in occupations of responsibility which before the era of technology were hardly known. Here we find the engineer, the secretary, the economist, the patent lawyer, the research scientist and many others. Those responsible for planning the work of society have never been so driven by ceaseless demands as in today's America. Reflections of this pressure are to be seen in the multiplication of governmental offices, in the rise of schools of business and public administration and in the growth of the army's staff of supervising officers. The masters of society have indeed become the servants of all, in an unresting labor that knows no release. By emphasizing the need for intelligent direction, and reducing the need for unskilled labor, technology is thus spurring Americans of all levels toward an ever higher standard of training and education.

Most significant, however, of the factors that make life worth while is the vision of a goal that one recognizes as worthy of his supreme effort. Now in wartime Americans find that goal in the victory that will preserve our freedom. When peace comes, what will be the objective that will unite our efforts? Will we be inspired by the new possibilities presented by science for making the world suitable for the highest needs of man? Here is a challenge of a millennium that science presents to religion. For is it not the great task of religion to show us the goals for which we should strive?

But whether we call it religion or humanism or social expediency, acceptable objectives must and will be found. This follows again from the fact that the will to cooperation needs a challenging purpose, and cooperation is essential to the survival of a social system. If we fail to develop adequate objectives our society will be replaced by another that has such objectives. It was Hitler's call to the youth of Germany to lose themselves in the greatness of the German Volk that gave such strength to what had been a sick nation. It was Lenin's challenge of a great new society based on equality of all and the glory of work for the common welfare that has made of modern Russia a mighty power. To Americans the values inherent in freedom had been almost forgotten. We were weak from lack of objective, until the Japanese attack united us to meet a common danger.

Perhaps the great objective for us will be that of the common welfare, as discovered by a hundred million citizens who become educated to the possibilities of common men. Leaders we have, and new ones must arise, who will give us the inspiration of great ideals.

As scientists, it is our primary task to give our country the strong foundation of science necessary for her proper growth. If we can also find for ourselves the way to useful and satisfying citizenship in the society built on that foundation of science, the world will follow our leadership.

To Daedalus, steel was much more than metal for

fashioning swords. It was the means of making men grow to greatness. So likewise science.

We have in science a powerful weapon with which to fight our war for freedom. If the powers in control will be vigilant and will establish a suitable policing system, science and technology are giving us a world in which a stable peace can probably be maintained. But science requires changes in our mode of life. The specialization of our society based on science must be matched by ever closer cooperation on a rapidly increasing scale. Growing attention to special training and more extensive education for leadership is inevitable. Such developments give promise of a truly great society. We are, however, in need of the inspiration of a commonly accepted social objective that will unite our willing efforts.

Never has man had so real an opportunity to master his own destiny. With the new ideas of science, the new tools of technology and the new view of man's place in nature that science has opened, we see ever more clearly how we can shape our world. May God grant us a vision of the possibilities of man which will challenge us to the worthy use of these great new powers.

OBITUARY

HERMON CAREY BUMPUS

May 5, 1862–June 21, 1943

THE long full life of Hermon Carey Bumpus was brought to its close on June 21, 1943, at Pasadena, Calif., the home of his elder son. He is survived by his widow, the former Ella Nightingale, and two sons, Dr. Hermon Carey Bumpus, Jr., and Dr. Laurin Dudley Bumpus.

Dr. Bumpus was bred and educated in New England traditions. He was born in Buckfield, Maine, and reared in Dorchester and Boston. His father was a much beloved Boston city missionary—an unordained pastor, his mother a woman of marked ability and vision, a former teacher.

Nature endowed him with exceptional charm of appearance, and manner, with dynamic, tireless energy and exuberant vitality that lasted well beyond the scriptural allotment of years.

He had a clear mind, wide intellectual interests and an exceedingly lively creative imagination which he relied upon, rather than upon tradition, habit or counsel to direct his course of action. This explains his proverbially direct and original approach to a problem. His own predilection for things which can actually be seen accounts for his confidence in the effectiveness of laboratory work in contrast with the lecture as a means of teaching and for the fact that his really great contribution to education in America must be attributed mainly to his genius for ocular demonstration in the laboratory, the museum and under the open sky.

His instinctive desire to point out to other people what had been discovered took on serious and ever-increasing importance. It inspired his teaching and, when he became responsible for the uses to which great educational resources both in materials and in scholarship were to be put, it became to him a prime moral obligation.

To Dr. Bumpus the mental habits and traits of human beings were important natural phenomena to be accepted and dealt with realistically and sympathetically; this attitude added a fine touch to the quality of his teaching, his museum work and his administration. As a teacher, he was inspiring and simply unforgettable. His methods were original, usually unorthodox, but always effective. His aim was to inspire and orient; it was never indoctrination. His advanced students and his junior colleagues still remember with gratitude how he kindled their enthusiasm and constantly encouraged and generously commended their individual initiative. He was a constant advocate of purposeful research in both the theoretical and the practical fields and he himself worked with equal enthusiasm in either field. As an administrator, Dr. Bumpus was singularly free from a desire for power, personal credit or substantial reward. His heart's desire was to "see things go." He was generous in giving credit to others for the success of mutual undertakings and in assuming blame when things went wrong; yet, when occasion required, he would fight to the last with ardor and enthusiasm for what he considered a matter of principle.

After Dr. Bumpus was graduated from Brown University in 1884, he spent two years there as assistant in zoology, taught zoology at Olivet College for three years, went as fellow to Clark University in 1889, and was the first recipient of a degree from Clark, a Ph.D. He returned to Brown to teach biology in 1890, and during his ten years at Brown he continued his very active teaching, organizing and administrative work at the Marine Biological Laboratory at Woods Hole until 1895. Later, at the U. S. Fish Commission, as scientific director, he restored the scientific features envisioned by its founder, Spencer F. Baird. Then followed ten years at the American Museum of Natural History, of which he became the first director, three years at the University of Wisconsin as the first business manager and five years as president of Tufts College. From 1924 until 1940 he was engaged in

organizing the educational program in the National Parks and concurrently he served for five years as consulting director of the Buffalo Museum of Science.

Dr. Bumpus played an important part in establishing or remodeling the policies and practices of several of these institutions. He also, as an active trustee, impressed his unmistakable hallmark upon many others.

It is not derogating from his accomplishments elsewhere to say that his most important work was done in the field of his primary interests, biology and natural history, and that it was at Brown University and concurrently at Woods Hole, at the American Museum of Natural History and in the National Parks that his creative and administrative talents found their greatest opportunity.

At the age of twenty-eight he deliberately set out to establish at Brown a department, in effect a biological institute, within the university which should combine the collegiate traditions of undergraduate teaching with the ideals of research which he had found at Clark University and which in turn were obviously derived from European universities of the seventies and eighties, via the Johns Hopkins. He proposed to introduce also the element of familiar companionship prevalent at Woods Hole, inherited from Agassiz's earlier laboratory at Penikese. Before his decade at Brown was over he had realized his vision in all essential respects. This demonstration of what collegiate education might be, which was novel fifty years ago, strongly influenced the development of the educational policy of the university.

In 1901, at the invitation of President Morris K. Jesup, Dr. Bumpus began his service at the American Museum of Natural History under conditions which contrasted sharply with those which he dealt with at Brown. The museum was a great institution, having already an amazing wealth of material, equipment and financial resources, both actual and potential. He entered the field, "when museums of nearly every type were just thawing out of their Ice Age." The thawing process was considerably accelerated both at the American Museum and throughout the country by his strenuous and eminently successful efforts in developing the educational functions of this museum and in founding the American Association of Museums (1905–06).

In the museum field, as in his university work, Dr. Bumpus held that both research and teaching were necessary for discharging the obligation of the institution as a whole to those in whose interest it was founded and maintained and that it is the responsibility of the administrator to see that these obligations are met. His old associates at the museum attest his staunch adherence to this proposition in his administration. A distinguished colleague has said: "Bumpus' cardinal principle in the conduct of his office was cooperation. He made it a point to form an almost daily contact with the head of each department, scientific, clerical and mechanical, and the breadth of his knowledge permitted him to meet each man on his own ground, and there was created a spirit of promptness and effectiveness that was diffused throughout the museum." The increasing confidence placed in him by President Jesup resulted in a "combination of authority and ability under the impetus of which the potentialities of the museum developed rapidly, and in *research, exhibition* and *education* it took its place among the leading institutions in its field."[1] After a change in the organization of the museum had substantially affected the authority which had gradually been vested in the office of director, and the official attitude of the museum toward popular education, Dr. Bumpus left the museum and, temporarily, the field of natural history to become a pioneer in the new field of university business management at the University of Wisconsin. After three years of signal success in this office, he was called to Tufts College as its president and successfully guided the college through the strenuous war years. In 1919 he left it with its prestige enhanced and its foundations strengthened.

In 1924 Dr. Bumpus returned to the field of natural history to take a leading part in organizing a nation-wide educational program in the National Parks. The purpose of this program was to point out and interpret the primeval, archeological and ethnological features of the parks to the increasing throngs of visitors and to provide the only reliable insurance for the preservation of a priceless national heritage by creating an intelligent interest born of understanding in the minds of the millions of voters who ultimately control its destiny.[2]

The desirability of such a program developed out of the earlier separate efforts of several enthusiastic park executives under the stimulus and support of certain influential citizens who visited the parks and became concerned over the immense unimproved opportunities for public enlightenment which they afforded. With the approval of the National Parks Service and supported by liberal grants from the Laura Spelman Rockefeller Memorial, the American Association of Museums undertook to implement this program. Dr. Bumpus, as chairman of its committee on outdoor education, was requested to assume leadership. He submitted a highly original plan for plac-

[1] Italics mine.

[2] The chief naturalist, Dr. Carl P. Russell, reports that "during the five-year period 1938–42 the average yearly number of visitors to the areas of the National Park System has been 17,000,000" and that "the great majority of these visitors have made use of the park museums. . . ."

ing at strategic points throughout the National Parks what he called "Trailside Museums" which were to be small museums located in the field. The natural features of the parks were to be the exhibits in situ and undisturbed. The buildings were to contain readily available sources of information and interpretation about them. It was characteristic of him that his solution was simple and direct and that he based his whole program squarely upon the psychology of "Everyman," who is naturally anxious to learn about the new things he sees around him. The function of the museums was to furnish reliable information while he is in this receptive mood. Dr. Bumpus was requested to create a model museum in the Yosemite to serve as a demonstration. This was done with the enthusiastic cooperation of the park executives. The success of this experiment was so complete and the validity of the basic idea so well attested that a succession of "trailsides" was soon established in other national parks, and eventually, as was hoped, the United States National Parks Service took over the program. Dr. Bumpus as National Parks Advisory Board chairman continued to be its guiding spirit. At present there are more than 200 such museums in national, state and municipal parks throughout the country, the offspring of the famous demonstration in the Yosemite. Happily, Dr. Bumpus lived to see his vision realized in the nation-wide adoption of his "Trailside Museum" idea.

When he reached the age of seventy-eight, Dr. Bumpus resigned from active leadership in this National Parks program and, in doing so, deliberately brought to its conclusion the active phase of his long career. In the formal awards of medals and in the documentary references to his life's achievements which followed, he was especially gratified by the acknowledgments of the correctness of his far vision in anticipating the results of the programs which he had projected so long before.

The Department of the Interior in its "Field Manual for Museums" acknowledges that the Manual itself "may well be regarded as evidence that the field museum program anticipated by Dr. Bumpus and his associates of the Committee on Outdoor Education is an established instrument in teaching Americans to know their heritage."

The American Scenic and Historical Preservation Society awarded the Cornelius Amory Pugsley Gold Medal in 1941 to Dr. Bumpus for "his creation and popularization of the trailside museums" and the president in his citation paid him high tribute as a zealous pioneer.

In 1941 the distinguished service award, officially the Henry W. Kent Diploma, presented to him by the American Association of Museums, also brought Dr. Bumpus complete and gratifying assurance that his early vision had been correct. No other body was so competent to judge of the trends in museum development and no person so intimately familiar with the whole range of Dr. Bumpus's museum work as its president, Dr. Clark Wissler, who gave the citation.

Finally in May, 1943, when Dr. Bumpus resigned as Senior Fellow of Brown University, having been a member of the board for nearly forty years, the Corporation abandoned the precedent of a hundred and seventy-five years and promptly elected him the first Fellow Emeritus.

Dr. Bumpus thoroughly enjoyed his stay upon this planet, which he found "so full of a number of things." He enjoyed pointing out these things in a new light to the men, women and children, high and low, who were here in his time, and he did not neglect the interests of those yet to arrive. At the last, he went on his way in a golden sunset aware that what he had done and the motive of it had won approval in the judgment of his peers.

A. D. MEAD

RECENT DEATHS

DR. WILLIAM EMERSON RITTER, professor of zoology at the University of California until his retirement with the title emeritus in 1923, who was from 1909 to 1923 director of the Scripps Institution of Oceanography at La Jolla, died on January 10 at the age of eighty-seven years.

DR. GEORGE OTIS SMITH, from 1907 to 1930 director of the U. S. Geological Survey, chairman of the Federal Power Commission in President Hoover's administration, died on January 10 in his seventy-third year.

DR. JOSEPH JASTROW, professor of psychology at the University of Wisconsin, where he was a member of the faculty from 1888 until his retirement in 1927 with the title emeritus, died on January 8 at the age of eighty years.

DR. CASWELL GRAVE, since 1919 professor of zoology and head of the department at Washington University, St. Louis, who retired with the title emeritus in 1940, died on January 8 in his seventy-third year.

DR. FRANK LEVERETT, formerly lecturer on glacial geology at the University of Michigan, died on November 15 at the age of eighty-four years.

DR. GEORGE A. PFEIFFER, associate professor of mathematics at Columbia University, died on January 4 at the age of fifty-four years.

DR. GEORGE CRANSTON ANDERSON, since 1932 secretary of the British Medical Association, died on January 1 at the age of sixty-four years.

A CORRESPONDENT writes: "Dr. Hans Becker, geologist for Socony-Vacuum Oil Company in Caracas, Venezuela, died in July, while engaged in active field work. Dr. Becker was formerly dozent in the University of Leipzig and professor at the National Central University in Nanking. His many publications dealt chiefly with the regional aspects of stratigraphic and structural geology, to which field he made important contributions. His early death, at a time when much of his work was incomplete, is greatly to be regretted."

SCIENTIFIC EVENTS

THE SCHOOL OF AGRICULTURE OF THE HEBREW UNIVERSITY OF JERUSALEM

THE Hebrew University of Jerusalem will graduate this year the first class of agronomists to be trained in Palestine. As recently as five years ago it was necessary for students who wanted professional training in scientific agriculture either to go abroad or to change their plans. The Hebrew University, in cooperation with the Agricultural Research Station of the Jewish Agency, has provided them with a School of Agriculture of university rank.

Though inaugurated in 1940, the School of Agriculture was formally opened late in 1942, when the senior class was ready for the professional courses in agricultural science, which are given in the new building of the School of Rehovoth. The head both of the School of Agriculture and of the Agricultural Research Station of the Jewish Agency is Professor I. Elazari Volcani. Professor Volcani is known for his pioneer research and experimentation in Palestine and for his long experience in practical farm management.

The five-year curriculum of the school, which is confined for the present to mixed farming as the most wide-spread form of agriculture in Palestine, is divided into three parts: two years' study of physics, chemistry, general soil science, geology, botany, zoology, bacteriology and meteorology at the university. These courses are followed by one year's practical work on the land. The fourth and fifth years are spent in Rehovoth, where the courses include practical as well as theoretical instruction in farm management, special soil science, field and garden crops, horticulture, citriculture, agricultural entomology, plant pathology and animal husbandry.

The two years' course in natural sciences at the university is also directly bound up—and not only theoretically—with the future professional work of the students. Their teachers are men and women who have long applied their researches to the practical problems of agriculture in Palestine and helped the settlers out of many a difficulty with the results of their experimentation.

The students learn how to apply science to agricultural problems in different countries in accordance with the local conditions peculiar to each. An essential fact that applies to these students is that they are at home in Palestine and mean to devote themselves to agriculture there. In view of the important services that they will soon be able to render on the vital home front, all have been excused from the duty of enlistment in the armed forces by the Jewish recruiting committees.

SUGGESTED BRITISH SCHOOL OF AERONAUTICAL SCIENCE

REPLYING to a question raised in the House of Commons on December 1, we learn from *Nature* that the Minister of Aircraft Production, Sir Stafford Cripps, announced that the Aeronautical Research Committee had recommended the creation of a new school of aeronautical science, coordinated with existing training facilities, to bridge what it considers to be a gap in the present system. This report is approved in principle by the government, and an interdepartmental committee has been appointed to prepare detailed proposals for its establishment. The committee is under the chairmanship of Sir Roy Fedden, sometime designer and chief engineer of the engine section of the Bristol Aeroplane Company. This company was one of the first in the aeronautical world to initiate an apprentice training school in its works under Sir Roy's guidance, and in addition he has just returned from a tour of the United States, where he has studied the systems of aeronautical instruction in use there.

Although the terms of the report were not announced, it is said to follow the scheme described by Sir Bennett Melvill Jones, the chairman of the Aeronautical Research Committee, in his remarks at a recent discussion on aeronautical education before the Royal Aeronautical Society. The school will be postgraduate and will be additional to the facilities of a similar standard at present available at universities. It will deal with advanced study and experimental work of a technical nature, leaving the more scientific and research aspects to the university schools. It is also hoped to include certain aspects of flying, incidental to the teaching. It is hoped that such training will appeal to the university graduate who desires to take up the more applied side of the profession, the

works apprentice who has attained a sufficiently high standard in theoretical study, and possibly senior men from the industry and the forces who desire refresher courses.

THE CHICAGO NATURAL HISTORY MUSEUM

THE Chicago Natural History Museum has been officially known by that name only for the past month, since the granting of an amended charter by the Secretary of State at Springfield changed the name of what was formerly Field Museum of Natural History. A statement made by Orr Goodson, acting director, reads in part:

> The museum's activities during 1943 continued to be tied in with the war effort. The institution's photographic collections and informational sources were placed at the disposal of the army, navy and other government agencies, and many members of the staff served as consultants on geographic and scientific subjects at the request of government bureaus. Some members of the staff contributed the information for manuals used by soldiers and sailors in far-off lands. For the public, special exhibits pertaining to some of the more important theaters of the war were arranged, and a special series of lectures, "Backgrounds of the War," was presented. To the degree that conditions permitted, all normal museum activities were continued. Attendance was nearly normal, with more than one million visitors received.
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> The opening of a new hall called "Indian America," devoted to archeology of the New World, was a major event of 1943. This hall represents a radically improved technique in anthropological exhibition methods, characterized by sparsity of labels and brevity of those which are used, the use of especially adapted fluorescent lighting, a liberal use of gay colors, and the inauguration of completely new ideas of exhibition, in which a graphic bird's-eye view of ancient cultures is substituted for large collections of artifacts. Despite shortages of personnel and of materials for construction, many other important new exhibits were installed in all departments of the museum—anthropology, botany, geology and zoology.

The following changes have occurred in the regular staff of the museum: Clifford C. Gregg, director, on leave for service with the army, has been promoted from the rank of lieutenant-colonel to colonel. Dr. C. Martin Wilbur, curator of Chinese archeology and ethnology, has been granted leave of absence to join the staff of the Office of Strategic Services, Washington, D. C. Dr. Julian A. Steyermark, assistant curator of the herbarium, and Llewelyn Williams, curator of economic botany, have been granted leave of absence to engage in foreign missions for the Board of Economic Warfare of the United States Government.

George A. Quimby was confirmed in his appointment as curator of North American archeology; Gustav Oscar Dalstrom was appointed artist in the department of anthropology; Dr. Alfred E. Emerson, Dr. Charles H. Seevers and Alex K. Wyatt were appointed research associates in entomology; Mrs. Roberta Cramer and Miss Emma Neve were appointed lecturers. After a year in service in Africa with the American Field Service, Bert E. Grove, wounded, was returned home, and rejoined the staff as lecturer. Alfred C. Weed, curator of fishes for twenty-two years, retired.

The honor roll of museum employees and trustees now engaged in war services numbers thirty-nine men and women.

THE AMERICAN STANDARDS ASSOCIATION

THE American Standards Association, a federation of national groups dealing with standardization, through which government, industry, labor and the consumer work together to develop mutually satisfactory national standards and which acts as the authoritative channel for international cooperation in standardization work, has announced the publication of a new list of standards. There are more than 600 standards listed, of which 64 have been approved or revised since the last price list was printed in April. The standards cover specifications for materials, methods of tests, dimensions, definitions of technical terms, procedures, etc.

One important phase of the work built up during the twenty-five years that the association has been in existence is in the field of safety engineering. The new list includes ninety-five safety standards. Standards are constantly revised to keep up with advances in industrial methods.

Since the war, the association has been working very closely with government agencies and with the Armed Services to provide specifications for certain of the materials necessary to the war effort. Because these standards are developed through an accelerated procedure, they are designated as American War Standards. These are listed separately, and to date there are forty already completed and many more under development. These war standards have been produced in the field of safety work, machine tools, quality control, photography and radio, just to mention a few. Every government order is based on specifications: standards are used to accelerate production, conserve materials, maintain a balance between quality and price control, simplify inspection, contracting and subcontracting. All are designed to relieve shortages of time, material and man-power.

In each case, the standards approved represent general agreement on the part of maker, seller and user groups as to the best current industrial practice. More than six hundred organizations are taking part in this work.

The complete list of American standards should serve as valuable reference material to engineers, manufacturers, purchasing agents, etc. It will be

sent free of charge to any one interested in the work. Requests should be addressed to the American Standards Association, 29 West 39th St., New York 18, N. Y.

MEETING OF BOTANISTS IN CHICAGO

According to a statement received from Dr. Scott V. Eaton, of the University of Chicago, there existed among botanists of the general Chicago region considerable sentiment in favor of holding an informal meeting during the Christmas holidays. Arrangements for such a gathering were made by the departments of botany of Northwestern University and the University of Chicago. The meeting was held at Chicago, on December 29 and 30. Announcements and programs were sent to the departments of botany or biology of the colleges and universities of Illinois, Indiana, Ohio, Michigan, Minnesota, Iowa, Missouri and eastern Nebraska.

Three sessions for the reading of invitation papers were held at the Chicago Academy of Sciences. The facilities provided by the academy were very much appreciated. On the morning of December 29, L. H. Tiffany was chairman of the program, and the speakers included Walter F. Loehwing, the State University of Iowa; Margery C. Carlson, Northwestern University; Neil E. Stevens, University of Illinois; Charles E. Olmsted, the University of Chicago, and O. C. Durham, Abbott Laboratories. The chairman on Thursday morning was Dr. John T. Buchholz, of the University of Illinois, and the speakers were Ralph E. Cleland, Indiana University; Leo R. Tehon, Illinois State Natural History Survey, and Ralph O. Freeland, Northwestern University. At the concluding session on Thursday afternoon John M. Beal, of the University of Chicago, presided, and those who took part were George S. Bryan, the University of Wisconsin; Kenneth E. Damann, Water Purification Division of Chicago, and Wendell R. Mullison, Purdue University.

The attendance at the sessions ranged from forty-five to seventy-four. The lateness of announcing the meeting and travel uncertainties, especially because of the threatened railroad strike, reduced the number of persons present. Also a number wrote that they could not attend because of their war teaching programs.

On Wednesday evening an informal dinner was held at the Webster Hotel with an attendance of fifty-three. Dr. Charles A. Shull, of the University of Chicago, was toastmaster, and after the dinner he called on several persons for brief after-dinner speeches.

The meeting was characterized by good fellowship and friendly visiting. All present seemed very glad of the opportunity of again attending a scientific meeting. It is hoped that even if the war has not yet ended the national officers of the various botanical societies will find it possible to organize meetings, either national or regional, for the next Christmas holidays.

BERMUDA BIOLOGICAL STATION FOR RESEARCH

The annual meeting of the corporation and a meeting of the trustees of the Bermuda Biological Station for Research, Inc., were held in New York City on December 18.

Officers elected for 1944 were: *President,* Columbus Iselin; *Vice-president,* A. G. Huntsman; *Treasurer,* Ross G. Harrison; *Secretary,* John H. Welsh.

Trustees elected to the class retiring in 1947 were: C. P. Curtis, Jr., P. S. Galtsoff, E. N. Harvey, Columbus Iselin, Stanley Kemp and Daniel Merriman.

The main building and cottages which were leased to the U. S. Army Engineers as a temporary hospital were vacated in June on the completion of the permanent Base Hospital. Dr. Hilary B. Moore, acting as resident custodian, is now occupying the director's cottage and three of the others are rented. Books have been removed from storage and the library has been placed in order.

The former director, Dr. J. F. G. Wheeler, has left Bermuda to take up a new position as fisheries director for the Island of Mauritius. The period of his directorship extended from 1932 to 1941. During this time there were over two hundred investigators who made visits of some length at the station. Eighteen of these were from England, France, Canada and Belgium. There were 138 published contributions covering a wide range of subjects of biological and oceanographic interest. While the main financial support of the station for this period came from income on investments of the original Rockefeller Foundation grant, there was additional support for maintenance and operation from the Bermuda Government of approximately $15,000. During the years 1937–41 the station also received $10,000 through the Royal Society, London, in support of oceanographic investigations. This was in addition to furnishing the research vessel *Culver.*

During the past year there was a net gain of income over expenses amounting to $10,368. Present total assets amount to $304,936. Approximately one third of this is invested in the Bermuda property and the remainder in income-yielding securities.

The location of the station is one of the best in Bermuda in spite of military developments in that region, the buildings are in an excellent state of repair, and the vicinity of Bermuda still remains a uniquely favorable place for investigating the biology, physics and chemistry of the open North Atlantic, especially in deep water. It is the expectation of the trustees that the station will reopen as soon as the progress of the war allows.

SCIENTIFIC NOTES AND NEWS

DR. HARVEY NATHANIEL DAVIS, president of the Stevens Institute of Technology, Hoboken, N. J., and director of the Office of Production Research and Development of the War Production Board, has been elected an honorary member of the Institution of Mechanical Engineers of Great Britain. He is the fourth living American to be so honored. The others are Henry Ford, Professor A. G. Christie, of the Johns Hopkins University, who were elected honorary members in 1939, and Orville Wright, who was elected in 1942. Dr. Davis returned recently from England, where he had been on a government mission for the Office of Production Research and Development and the Combined Production Resources Board of Great Britain, Canada and the United States.

THE Medal of Honor of the Institute of Radio Engineers for service in the field of radio communication has been awarded to Haraden Pratt, vice-president and chief engineer of the Mackay Radio and Telegraph Company and of the Federal Telephone and Radio Corporation, affiliates of the International Telephone and Telegraph Corporation.

SIR GIRLING BALL was appointed Bradshaw Lecturer for the year 1944, at a recent meeting of the council of the Royal College of Surgeons.

DR. M. A. STEWART, associate professor of parasitology at the University of California, has been elected president of the Pacific Coast Entomological Society. Dr. E. Gordon Linsley, assistant professor, has been reelected secretary.

THE American Association for Applied Psychology in September, 1943, authorized the establishment of a Section of Military Psychology. Officers appointed by the Board of Governors are Major T. W. Harrell, AC, office of assistant chief of air staff for personnel, *Chairman;* Lieutenant C. Gilbert Wrenn, U. S. Naval Reserve, Bureau of Naval Personnel, *Secretary.* The present objectives of the section are: (1) to encourage professional relationships among psychologists in the armed services; (2) to provide for the continued availability to the armed services of technical advances in psychology both during and following the war period. Up to January 1, 90 members of the association had joined the section out of about 115 eligible for membership. Of this group of 90, there are 50 serving in Army billets, including the Air Corps, and 40 from the Navy, including the Marine Corps and the Maritime Service.

DR. WALTER B. CANNON, professor emeritus of Harvard University, has been appointed visiting professor of physiology at the New York University College of Medicine.

DR. PHILLIPS FOSTER GREENE, professor of surgery at the Hsiang Ya Medical School, Changsha, China, has been appointed visiting professor of surgery from December 1, 1943, to July 1, 1944, at the Long Island College of Medicine. The appointment was made possible under the terms of a grant from the Commonwealth Fund to encourage the exchange of members of the teaching staff of various medical schools.

DR. LOYAL DURAND, JR., of the department of geography of the University of Wisconsin, has been appointed associate professor in the department of geology and geography of the University of Tennessee. He will take up his new work on February 1.

DR. L. R. WAGER, lecturer in petrology at the University of Reading, England, has been appointed professor of geology at the University of Durham.

DR. JAMES ROWLAND ANGELL, consultant in education for the National Broadcasting Company, formerly president of Yale University, has been appointed to succeed the late Professor William Lyon Phelps as director of the Hall of Fame of New York University.

DR. GUY F. MACLEOD, professor of entomology at the University of California, has been appointed chief of the chemicals and fertilizer branch of the Chemical Division of the War Food Administration.

J. C. MARQUARDT, assistant professor of dairying at the New York State Agricultural Experiment Station at Geneva, has resigned to become assistant director of the division of milk control for the New York State Department of Agriculture.

DR. WILFRED F. HORNER, of the department of biology of Loyola University, Chicago, is now equipping a new biological research laboratory for the Belmont Radio Corporation in Chicago.

DR. ALBERT E. MEDER, JR., professor of mathematics at the New Jersey College for Women, has been appointed secretary of Rutgers University. Dr. Richard Morris has retired as head of the department of mathematics at the New Jersey College for Women.

JAMES E. FENN, chief research chemist of the Gummer Products Company, Troy, Ohio, has resigned his position to join the staff of Johnson, Salisbury, Inc., Consulting Laboratory in New York City.

FRED ERNSBERGER has been reappointed research fellow at the Research Foundation of the Ohio State University. He is working on the cement rehydration project sponsored for the past three years by the Master Builders Company of Cleveland, Ohio.

MRS. ALBERT D. LASKER, of New York, and Dr. George H. Preston, Maryland State Commissioner of

Mental Hygiene, president of the American Orthopsychiatric Association, have been elected members of the board of directors of the National Committee for Mental Hygiene.

DR. CURTIS SAUNDERS, M.R.I.P.H.H., master sergeant, in the Division of Parasitology and Tropical Medicine, Army Medical School, Washington, D. C., has been appointed Captain in the Sanitary Corps, Army of the United States. He will be on duty at the Army Medical School.

AT the Central Laboratories, Hoboken, N. J., of the General Foods Corporation, Dr. Aksel G. Olson succeeds as manager Thomas M. Rector, now vice-president in charge of research and development. Dr. Roland E. Kremers has been appointed director of basic research, with supervision over the sections of organic chemistry and physical research and the newly established section of biochemistry. The following directors have been appointed: Dr. Harry M. Barnes, of the section of organic chemistry; Harvey K. Murer, of the section of biochemistry; Charles W. Kaufman, of the section of processing technology; Dr. Willard L. Roberts, of the section of cereal technology; Hamilton W. Putnam, of the division of cereal chemistry, and Dr. Martha Johnson, of the division of analytical chemistry.

PROFESSOR L. J. WITTS, Nuffield professor of clinical medicine at the University of Oxford, and Professor J. R. Learmonth, surgeon to H.M. Medical Household in Scotland, professor of surgery in the University of Edinburgh and surgeon-in-ordinary of the Edinburgh Royal Infirmary, have been appointed members of the British Medical Research Council.

SIR RICHARD GREGORY, president of the British Association for the Advancement of Science, was recently chairman of a deputation of scientific men to Robert Foot, director-general of the British Broadcasting Company, to ask for better and more frequent scientific broadcasts.

DR. HOWARD T. KARSNER, professor of pathology and director of the Institute of Pathology of the School of Medicine, Western Reserve University, will deliver the eighth Christian Fenger Lecture of the Institute of Medicine of Chicago and the Chicago Pathological Society at the Palmer House on February 14. His subject will be "Calcific Aortic Stenosis."

DR. DETLEV W. BRONK, Johnson professor of biophysics and director of the Eldridge Reeves Johnson Foundation for Medical Physics of the School of Medicine of the University of Pennsylvania, will deliver the second Walter Wile Hamburger Memorial Lecture of the Institute of Medicine of Chicago on January 28. The lecture will be entitled "Cardiovascular Problems in Military Aviation."

PROFESSOR KARL S. VAN DYKE, chief physicist of the Quartz Crystal Section of the Engineering and Technical Service of the Office of the Chief Signal Officer, Army Service Forces, War Department, Washington, D. C., now on leave of absence from Wesleyan University, made an address entitled "Standardization of Quartz Crystal Units" on January 5 before the New York Section of the Institute of Radio Engineers.

DR. JAMES C. MAGEE, Major General, U. S. A. (retired), a former Surgeon General and now director of Medical Informational Service of the National Research Council, recently addressed a special meeting of the staff and students of the Medical Branch of the University of Texas at Galveston, on the significance of tropical diseases before and after the war. The address was sponsored by the Association of American Medical Colleges and the John and Mary R. Markle Foundation.

AT the fifty-seventh annual convention of the Association of Land-Grant Colleges and Universities, held in Chicago in October, the vice-president, C. B. Hutchison, dean of the College of Agriculture of the University of California, was elected president, with C. S. Boucher, of Nebraska, vice-president, and Thomas P. Cooper, of Kentucky, secretary-treasurer. C. A. Dykstra, of Wisconsin, and M. S. Eisenhower, of Kansas, were elected to the executive committee for four-year terms, and W. H. Martin, of the New Jersey Agriculture Experiment Station, was elected to fill the two-year term vacancy created by the death of C. E. Ladd.

THE third annual meeting of the Society of Vertebrate Paleontology, held in the Sinclair Library of Princeton University on December 30, was devoted entirely to business matters and was attended by the officers, C. W. Gilmore, *President;* G. L. Jepsen, *Secretary-treasurer,* and E. H. Colbert, *proxy* for instructed votes. Ten new members were elected.

A WAR production conference for the solution of manufacturing problems, sponsored by the Engineering Societies committee on war production at the request of the War Production Board, was held at the Hotel Commodore, New York City, on January 14. The program was devoted to the interchange of practical ideas and discussion of common problems. There was a dinner in the evening at which Ralph S. Damon, vice-president and general manager of the American Air Lines, Inc., was toastmaster. Captain Eddie Rickenbacker, president and general manager, Eastern Air Lines, Inc., gave an address entitled "Production Responsibilities for 1944." In the afternoon panel meetings were held on the following subjects: chemical industries; metallurgical

problems; transportation; civilian requirements; safety on and off the job and foundry industries and in the evening manpower utilization; welding problems; production and tool engineering; metallurgical problems and foundry industries.

The *Journal* of the American Medical Association reports that the first Inter-American Congress of Radiology was recently held in Buenos Aires under the presidency of Dr. Jose F. Merlo Gomez. Delegates to the congress resolved (1) to create an Inter-American College of Roentgenology in Buenos Aires, (2) to stimulate the creation of laws in Pan American countries to promote roentgenology and protect roentgenologists and (3) to provide for retirement of roentgenologists if they become victims of the practice of roentgenology. At the close of the congress a monument in honor of Roentgen, Curie and the victims of roentgenology was unveiled in the Instituto Municipal de Radiologia y Fisioterapia of Buenos Aires.

In its recent report the National Central Library of London, according to *The Publishers Weekly*, records a partial list of the book losses during two years of bombing of the English libraries: National Central Library—105,000 volumes lost, Birmingham Natural History Library—completely destroyed, Coventry Public Library—completely destroyed, Exeter Public Library—almost destroyed, Liverpool Public Library—150,000 volumes lost, Manchester Literary and Philosophical Library—completely destroyed, Plymouth Proprietary Library—completely destroyed, Plymouth Public Library—completely destroyed, University of London Library—many thousand volumes lost, University College Library, London—about 100,000 volumes lost.

DISCUSSION

THE DEMONSTRATION OF TONIC NECK AND LABYRINTHINE REFLEXES AND POSITIVE HELIOTROPIC RESPONSES IN NORMAL HUMAN SUBJECTS

In decerebrate animals, in newborn infants and in functionally decerebrate or decorticate adult human subjects, rotation or tilting of the head to the side results in extension of the fore and hind limbs of that side and flexion of the limbs of the opposite side. Similarly, backward tilting of the head increases extensor tonus in both fore limbs and diminishes the tonus of the hind limbs. Forward tilting of the head produces opposite results. These phenomena are not ordinarily demonstrable, in clear-cut fashion, in normal adults, but when extensor muscles of the limbs are rendered hypertonic, by the procedures to be described, tonic neck and labyrinthine reflexes are elicited in striking fashion.

If one stands in a narrow doorway and stretches the extensor and abductor muscles of both arms for one to two minutes by exerting strong lateral pressure against the backs of the hands, placed against opposite doorposts, it is found, on standing away and relaxing all voluntary effort, that the arms float toward a horizontal position in a surprising manner. The reflex extensor hypertonus, responsible for the effect of this well-known parlor trick, gradually subsides during a minute or less and the arms fall slowly, or suddenly, to the sides. The mechanism of augmentation of the stretch reflexes, upon which this hypertonus probably depends, has been a s[illegible]t for speculation.[1] Whatever the mechanism, the increased tone provides a basis for the study of the tonic neck, labyrinthine, eye, crossed extensor, nociceptive and various positive and negative combinations of these reflexes in normal subjects.

During "levitation" of the arms, turning or tilting the head to the right, or turning the eyes strongly to the left, or shining a strong light into the eyes from the left increases the abduction of the right arm and diminishes or abolishes tonus in the left arm. The reverse positions of the head or eyes or light cause the left arm to rise again to some degree and the right arm to drop. Forceful downward rotation of the eyes or light from below, or backward tilting of the head increases the tonus and degree of abduction of both arms, while upward rotation of eyes or light from above or ventriflexion of the head reduces tonus in both limbs. A crossed extensor reflex, resulting from strong voluntary flexion of one elbow, facilitates reflex extension on the opposite side. Painful stimulation, as by pinching, quickly abolishes tonus on the affected side. The reflexes mentioned may be combined successively or simultaneously in various patterns of facilitation and inhibition of the extensor tonus.

Temporary hypertonus of the knee extensors results from pushing the toe of one shoe against a wall. The resulting hypertonus may be modified by eye, neck and labyrinthine reflexes, as in a decerebrate animal.

A slight degree of hypertonus of the flexors of the elbow or knee may follow prolonged voluntary contraction of these muscles against resistance. Tonic neck, labyrinthine and eye reflexes produce the ex-

[1] A. Schwartz and P. [illegible]er, *Compt. rend. Soc. Biol.*, 85: 490, 1921.

pected alterations, which are, of course, opposite in sign to those affecting extensors of the same joints.

These various studies on postural tonus are best observed by the subject himself, for he alone can be certain that they are involuntary phenomena. However, they have been tried on numerous persons who were not aware of the responses to be expected, and the results, so far, have been concordant.

The evidence for the effects of light on muscle tonus, which has been obtained in the course of these studies, indicates that man possesses latent positive heliotropism. As demonstrated by Garrey[2] for the robber fly, the alterations of tonus are directed in such a way as to assist in turning the body toward the light.

Observations on these reflexes have proved very useful for the teaching of neurophysiology. It is hoped that they may also be of assistance in evaluating the degree of excessive or diminished tone of muscles in neurological examinations or in tests of fitness or fatigue.

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CHOLINESTERASE

In Science (November 19, 1943) an attempt has been made by de Laubenfels[1] to claim for Alles and Hawes the priority of our discovery that two distinct cholinesterases exist in the animal body: a specific or true cholinesterase and a non-specific or pseudo-cholinesterase.[2]

Alles and Hawes,[3, 4] to whose work we referred in our first communication,[2] consider the cholinesterase activity of whole blood as due to the activities of a serum and a cell enzyme. This classification is based on a misconception. Experiments reported by us[5] show that the cholinesterase activity of serum is due to the presence of two distinct enzymes, one of which is specific like the enzyme in red blood cells[2] and brain,[6] the other being a non-specific catalyst. Consequently, any statement regarding the properties of the so-called serum enzyme would always refer to the properties of a mixture of these two enzymes. De Laubenfels' assertion that Alles and Hawes, who moreover were unaware of the existence of a specific and a non-specific enzyme, have "thoroughly demonstrated" the existence of the true and pseudo-cholinesterase is therefore invalid.

Regarding de Laubenfels' suggestion that the authors select more suitable names for discriminating between the two enzymes, we feel that the prefix "pseudo" emphasizes the non-specificity of the enzyme to which the name cholinesterase, suggestive of substrate specificity, has hitherto been applied. As we mentioned in the article in Science, the term "pseudo-cholinesterase" has been provisionally chosen until such time as the physiological function of this enzyme has been determined.

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[2] W. E. Garrey, *Jour. Gen. Physiol.*, 1: 101, 1918.

[1] M. W. de Laubenfels, Science, 98: 2551, 450, 1943.

[2] B. Mendel and H. Rudney, *Biochem. Jour.*, 37: 1, 59, 1943.

[3] G. A. Alles and R. C. Hawes, *Jour. Biol. Chem.*, 133: 2, 375, 1940.

[4] R. C. Hawes and G. A. Alles, *Jour. Lab. and Clin. Med.*, 26: 5, 845, 1941.

[5] B. Mendel, D. B. Mundell and H. Rudney, *Biochem. Jour.*, 37: 4, 473, 1943.

[6] B. Mendel and H. Rudney, Science, 98: 2539, 201, 1943.

APPARENT TIME ACCELERATION WITH AGE

I have read the letters to Science on the apparent time acceleration with age, and I should like to add a comment that is based on a study of numbers I made several years ago. My thought is that our sensations of elapsed time is strongly influenced by the number of remembered and half-remembmered things that have occurred. Thus at age ten a single day may bring to a boy a number of new events, sensations and thoughts, while at 50 a considerably greater time must elapse before an equal increase is accumulated. These things that fix themselves in our memories are our units of time, and if at 50 a week passes without a remembered event that week is telescoped toward the vanishing point.

An astonishingly large number of natural phenomena are arranged on a logarithmic scale. Thus we may say that an eleven-pound dog is slightly larger than a ten-pound dog, but an 801-pound horse is the same size as an 800-pound animal. Here we would require an 880-pound horse (+10 per cent. as in the case of the dog) before we would admit a perceptible difference. This mode of thought, which sets up a logarithmic scale of measurement, is inherent, I believe, and it has strongly influenced our factual literature, of which memory of past events is a part.

Returning to our sense of elapsed time, I believe that we must add a fixed fraction to our accumulated sense of time before we admit the addition of a new unit, and this makes our elapsed time sense follow the same law that governs our sense of brightness, loudness, weight, etc.

Frank Benford

I have been interested in the discussion of the apparent acceleration of time with the age of the

individual, but I am wondering if we are not really thinking of our present recollection of the passage of time in youth and in later years rather than of the actual feeling of the passage of time that we experienced as it passed. Of course, no individual can compare his own time sense with that of any other individual, younger or older, because such sense is purely subjective and there is no basis of comparison; and it would seem practically impossible, too, for any of us to remember just how fast the days and months seemed to go by at any particular period in his past, so that here again we have no good basis for comparison. We can, however, compare the elapsed time between the remembered events of our past as they now lie in our memories. In my own case the elapsed time between my tenth and my twentieth years, for instance, seems much greater as I look back upon it than that between my fortieth and fiftieth. The reason for this I believe to be that in later years things that happened after we reached maturity seem much nearer *in proportion* than the events of childhood and youth, and this because we feel that they might have happened only yesterday, whereas the youthful happenings belong to another age.

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I HAVE read with much interest the papers recently published in SCIENCE as a sequel to a first discussion inaugurated by Frank Wilen some time ago on the "Apparent Time Acceleration with Age." However, I was surprised at the purely psychological treatment of the question and at the fact that all your contributors seemed to think that they were dealing with a new subject. May I remind them that the problem has been thoroughly investigated since 1916, when the first paper on the influence of age on the process of cicatrization was published in the *Journal of Experimental Medicine* (xxiv, 461), then in the *Proceedings* of the American Philosophical Society (1917) and later in the C. R. Ac. Sc., etc. The notion of "physiological time," different from physical time and its method of measurement, were introduced by the writer and discussed by many authors in this country, Professor Hoagland among others. It was fully developed (mathematically and psychologically) in a book published six years ago in New York.[1] Last year, at the April meeting of the American Philosophical Society, the writer presented a paper in which the different aspects of the question were expounded at length. An interesting discussion followed. I feel certain that Messrs. Carlson, Abbott and Harriss will be interested by the odd ten papers and the two or three books dealing exhaustively with this problem in a strictly scientific way, published up till 1936 in the United States, England, France and Germany. The most important references are to be found in the book mentioned below.

P. LECOMTE DU NOÜY

[1] Lecomte du Noüy, "Biological Time," Macmillan, N. Y., 1937.

THE SCIENCE MOBILIZATION BILL

THE letter from Dr. Leland H. Taylor on the Science Mobilization Bill (SCIENCE, November 26) seems to miss the point. He bases his argument on generalities, which are no answer to the specific objections to the specific provisions of the Kilgore bill which its opponents have adduced.

For instance, Dr. Taylor formulates two "pertinent" questions. The first reads, "Does our present organization of science promote the fullest advancement of scientific knowledge?" Since no human institution is perfect, the answer is obviously "No," but how helpful is it in determining whether the specific provisions of the Kilgore bill will accelerate or retard that advancement? Precisely the same comments apply to Dr. Taylor's second question.

Dr. Taylor seems to take at face value certain sweeping charges against industry which have been made in Washington. Does an accusation amount to proof which a scientist should accept? Has Dr. Taylor read the detailed refutation of many of those charges? He complains that only "a few liberal journals of small circulation" (does he so characterize *The New York Times* and *New York Herald Tribune*, which gave full space to those charges?) printed the accusations. The fact is that the charges were given much more space than the subsequent refutations, which may explain why Dr. Taylor missed the latter.

But even if the charges are accepted as proof, the case reads about as follows: Industrial research has resulted in inventions; inventions have been patented; and patents have in a few cases been unfairly used to extend monopoly beyond the bounds of the legitimate restricted monopoly which every patent confers. Therefore research must be reorganized and put under different control. An analogous case would be—research has produced a new and better alloy; that alloy has been used to make better knives; a few individuals have used those knives to commit murder. Therefore we must reorganize metallurgical research and put it under different control. Would it not be more logical to enforce, and strengthen, if need be, the laws against unfair restraint of trade and homicide?

Finally Dr. Taylor makes much of "selfish interest" as the mainspring of present industrial research, and condemns it. Others call it "enlightened self-interest," and praise it. What other motive force would Dr.

Taylor suggest short of compulsion? After all, the two phrases differ essentially only by the word "enlightened." Discussion such as Dr. Taylor's may further enlightenment, but what has it to do with the virtues or faults of the specific provisions of the Kilgore bill?

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SCIENTIFIC BOOKS

MAN

Man Real and Ideal: Observations and Reflections on Man's Nature, Development, and Destiny. By EDWIN GRANT CONKLIN. xvii + 247 pp. New York: Charles Scribner's Sons, 1943. $2 50.

IN 1921 Charles Scribner's Sons published Professor Conklin's "The Direction of Human Evolution." An important philosophical discussion, this volume was scarcely appreciated because the publishers failed to do anything much in calling it to the attention of scholars. It is sincerely to be hoped that the same fate will not follow the present book. It richly deserves the widest possible distribution and consideration.

As president of the American Philosophical Society, Dr. Conklin is most appropriately filling his position by significant philosophical leadership, at a time when the whole world needs a clear exposition of the philosophical implications of science. Our current philosophers are not very helpful. Few of them understand science. Most of them seem to fear it.

Last year *Fortune* published a series of philosophical articles by such leading American philosophers as Hocking, Sperry, Montague and Maritain, most of whom clung tenaciously to scientifically outmoded positions of intuitionism, mysticism and philosophical idealism. The net impression was that the best to be offered by American philosophy for the future of the world is reliance on wishful thinking and the support of supernatural agencies. It seems to have taken an Englishman to suggest something more worthy of intelligent consideration. *Fortune* was kind in accepting an article from Julian Huxley giving a brief but clear statement of the philosophical implications of modern science. This appeared in December, 1942. It is remarkable that current philosophical problems should after all be important enough for the attention of business men and executives for whom *Fortune* is designed. It is regrettable that the editors of *Fortune* failed to include Conklin in the symposium.

Dr. Conklin agrees with Huxley that the state of our present knowledge of ourselves and our environment leaves little room for hoping that supernatural powers exist to bring us the salvation we crave. Science seems to indicate that responsibility for the future of mankind is on the shoulders of men.

That the implications of our developing verifiable knowledge of ourselves and our environment, as revealed by scientific inquiry, have significant moral consequences is a conclusion reached by many competent biologists. The statements made by C. Judson Herrick (*Sci. Monthly*, 49: 99, 1939) and S. J. Holmes (SCIENCE, 90: 117, 1939) agree with those expressed by Conklin. In a remarkable discussion aroused by C. H. Waddington ("Science and Ethics," London, 1942) there is further agreement with the conclusion that our morals are phases of our adaptation to our environment, and thus enable us to develop control of some of our evolutionary progress. It remains to be determined whether or not there is a naturally operative principle regarding human relationships which may have ethical significance. A tentative formulation of such a principle has already been attempted (*Nature*, 141: 783, Dec. 27, 1941).

Dr. Conklin appreciates very clearly what he is doing: "The results of the scientific study of man and philosophical conclusions that are derived from such a study run counter to the inherited traditions and cherished beliefs of multitudes of persons." He is convinced that all phases of human nature are amenable to scientific treatment and must be studied, if studied at all effectively, by scientific methods. These methods consist of careful, systematic, verifiable observations of phenomena, and logical deductions as to their causes, which deductions are then tested by further observations, and, whenever possible, by experiments aimed at isolating various factors or causes. As a biologist, Professor Conklin emphasizes the importance of biological methods in dealing with men. These methods are comparison, analysis, and experiment.

The volume offers a well-organized, comprehensive and brief survey of our present knowledge regarding the human species, tracing the past evolution of man, and discussing paths of progress, natural selection and organic selection as factors in progress, the role of eugenics, and future factors in the evolution of man.

Conklin clearly indicates the conclusions which the biologist must reach on the time-honored mind-body problem—that no distinction is valid. An assumed distinction is as semantically invalid as that between what is considered to be living from that which is thought to be dead.

Dr. Conklin then considers the development of the individual, with discussions of asexual and sexual reproduction, and factors in development, with a careful treatment of mechanisms of differentiation involving cells, chromosomes and genes. In discussing rela-

tions between structure and function Dr. Conklin reveals increasing complexity of organization as more efficient adaptation. Carefully he considers factors in psychic and social development.

The philosophical portion of Dr. Conklin's book deals with the antagonism of science and tradition in which scientific evidence is contrasted with emotional belief. One may infer that Conklin would hold that science sets the limits to belief and faith. He insists on the unity of nature and emphasizes the importance of biological satisfaction in living things. This adaptation for satisfaction becomes the basis for a biological appreciation of value, and for a biological basis for ethics. Ideals are emphasized by Professor Conklin as highly significant if appreciated as goals toward which it may be possible to develop. This offers a basis for a sort of scientific religion.

Of course, the volume must be carefully read in order to appreciate the skill with which Professor Conklin develops his thesis. His achievement is highly artistic and his work is earnestly commended to the sincere study of philosophers, scientists and scholars.

First delivered at Rice Institute, Houston, Texas, in 1941, the lectures comprising this book have already been published in part in the *Rice Institute Pamphlet* (28: 153–281, 1941). It is sincerely to be hoped that Professor Conklin's effort, in relation to many similar attempts by his scientific and philosophical colleagues, may result in a United Nations symposium on science and ethics. Such a symposium might lead to international agreements on articles of a scientific faith that might be very instrumental in helping us to obtain the sort of a peaceful and satisfying world which we all want.

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OPTICAL CRYSTALLOGRAPHY

Optical Crystallography. By ERNEST E. WAHLSTROM, professor of mineralogy, University of Colorado. $5\frac{1}{2} \times 8\frac{1}{2}$ inches. v + 206 pp. 209 figs. New York: John Wiley and Sons, Inc. London: Chapman and Hall, Ltd. 1943. $3.00.

THIS well-designed new text-book is a welcome boon to the students of optical crystallography. The author covers the essential phases of his subject in seventeen short but pithy chapters under the following headings: 1. Crystallography; 2. Physical properties; 3. Elementary optics; 4. The polarizing microscope; 5. Optics of isotropic substances; 6. Measurement of index of refraction; 7. The Uniaxial Indicatrix; 8. Polarization of light; 9. Uniaxial crystals in plane-polarized light; 10. Uniaxial crystals in convergent polarized light; 11. Optical accessories; 12. Sign determination in uniaxial crystals; 13. Biaxial crystals—the triaxial ellipsoid; 14. Biaxial crystals in convergent polarized light; 15. Determination of optical sign in biaxial crystals; 16. Dispersion in biaxial crystals; 17. Microscopic examination of nonopaque substances.

The text contains numerous (209) selected illustrations, including line drawings, half-tone reproductions and stipple-shaded diagrams. Approximately 80 pages of the 206-page book are occupied by illustrations. Diagrams designed to illustrate the three-dimensional visualization of the relationships between crystallographic directions and optical directions are well constructed and will give valuable aid to students who find difficulty in visualizing three-dimensional relationships.

In addition to the author's original material, he has brought together items and illustrations from other good sources and arranged them in a unified order so as to make it easy for the user to get the information he seeks.

His definitions have been carefully written in clear simple language to keep within the understanding of the user. This feature along with others shows the author's recognition of the fact that it is the function of a text-book to inform those who do not know.

In the first half of the book the author reviews briefly the principles of optical crystallographic theories, emphasizing only fundamental ideas; in a few pages discusses the physical properties of crystalline substances, and devotes a short chapter (6 pp., 9 figs.) to elementary optics dealing principally with the nature of light, followed by a well-illustrated chapter on the construction of the polarizing microscope. In the opinion of the reviewer, the chapter describing optical accessories—quartz wedge, gypsum plate, mica plate, etc., recognized as standard equipment—might well follow the chapter on the polarizing microscope.

In the author's discussion of refraction, reflection and the measurement of the indices of refraction (24 pp., 22 figs.), he describes several variations of the immersion method and other methods, using numerous and effective diagrams.

Since immersion media are an invaluable part of the equipment when working with crystal fragments, it will interest the reader to know that a more satisfactory, very inexpensive series of low-index liquids[1] has replaced the alcohols, butyrates and volatile distillates given on page 45. Isopropyl acetate (1.385, very slowly volatile), and diethyl oxalate (1.408) and dibutyl phthalate (1.490), both non-volatile, are miscible in all proportions and are colorless, viscous, odorless, and do not react with mineral grains within that range. The author did not have this information.

[1] These liquids may be purchased from U. S. Industrial Chemicals, Inc., 3200 N. 17th Street, Philadelphia, Pa., for $1.00 per pound.

The last half of the book is devoted largely to the interpretation of optical phenomena exhibited by uniaxial and biaxial crystals in both plane polarized light and in convergent polarized light under a petrographic microscope. By difficultly constructed diagrams and by clear, simplified explanation of optic-axis interference figures, optical signs, dispersion, etc., the author has clarified many points that cause trouble but are not covered in the average text on mineralogy.

To summarize, it is safe to say that this book stands alone in its field. In the opinion of the reviewer it is the most readable and most usable book on the subject of optical crystallography that has yet been produced. It will undoubtedly serve the purpose for which the author designed it—for use in college courses in optical crystallography and optical mineralogy. It will also, no doubt, become an indispensable handbook for all investigators interested in its practical applications in other fields of endeavor.

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SPECIAL ARTICLES

VENEZUELAN-TYPE EQUINE ENCEPHALOMYELITIS VIRUS IN TRINIDAD

VENEZUELAN-TYPE equine encephalomyelitis virus is the agent of a severe equine encephalomyelitis which has been occurring in Colombia[1] since 1935 and in Venezuela[2] since 1936. In 1941 it seems to have invaded also the northern coast of Ecuador.[3]

The corresponding virus has been isolated in Venezuela by Kubes and Ríos in 1938.[4] The comparative immunological studies[5,6] determined this virus as *sui generis,* differing from both the U. S. eastern and western encephalomyelitis strain. Neither has there been found any specific relation to the rabies virus.[7] On the contrary, an immunological identity with the encephalomyelitis virus isolated later in Colombia has been demonstrated.[8]

With regard to Trinidad, this island was considered free from this disease, until this colony's Department of Agriculture[9] announced on October 2, 1943, the first outbreak of it in the southern part of the island, *i.e.,* in the zone opposite the Venezuelan territory. There, 47 cases in all have been diagnosed, 30 in the San Francique Pluck-La Fortune area and 17 in the Debe-Penal area. Eight animals survived the infection.

[1] J. E. Albornoz, Suppl. to *Bol. de Agric.,* No. 26: 1, 1935, Bogotá, Colombia. Published by Ministerio de Agricultura y Comercio.

[2] V. Kubes, "La peste loca de las bestias. Sus manifestaciones, tratamiento y prevención." Caracas, Venezuela, 1936. Published by Ministerio de Agricultura y Cría.

[3] Personal communication from Servicio Veterinario Oficial, Guayaquil, Ecuador, 1943.

[4] V. Kubes and F. Ríos, SCIENCE, 90: 20, 1939.

[5] C. E. Beck and R. W. C. Wyckoff, SCIENCE, 88: 530, 1938.

[6] V. Kubes and A. Diamante, *Bol. Inst. Inv. Vet.,* Caracas, 1: 49, 1942.

[7] V. Kubes and F. Gallia, *ibid.*: 81.

[8] V. Kubes, *The Puerto Rico Jour. Pub. Health and Trop. Med.,* June, 1943: 391.

[9] Official statements of the Department of Agriculture, Trinidad, B. W. I., Oct., 1943.

On October 19, 1943, we received through the courtesy of Major Gilyard from the U. S. Army Veterinary Corps, by this time on the island, two samples of material collected in the infected area some days before: material No. 4 from a horse and material No. 5 from a mule, both in form of brain tissue conserved in a sterile glycerine solution. By intracerebral inoculations of those materials (a 5 per cent. brain-tissue suspension in saline) into white mice and guinea-pigs the presence of a virus has been established in both of them. Material No. 5 has had an especially rich virus content.

The isolated agent showed the same properties as the Venezuelan encephalomyelitis strain in Swiss white mice, guinea-pigs and developing chick-embryos. Swiss white mice, from the second or third passage on, given intracerebrally 0.02 cc of a 10 per cent. brain-tissue suspension in saline, died in from 3 to 5 days. In guinea-pigs inoculated with the same suspension (0.2 cc intracerebrally), the course of the disease was still more rapid. The same suspension dropped on to the chorio-allantoic membrane of eleven-day-old chick-embryos killed them in between fifteen to twenty hours, their bodies showing hemorrhagic infiltrations equal to those produced by the Venezuelan encephalomyelitis virus.

In order to demonstrate the concentration of the virus in the brain-tissue of mice and in the chick-embryos, the titration was started from a 1 per cent. suspension in saline of 7 mouse brains, on the one hand, and of 16 chick-embryos on the other, with a view to eliminating possible individual influences. The titration has been carried out in white mice by the inoculation of 6 of them with 0.02 cc of each tenfold dilution. The mouse brain tissue suspensions were mortal in 100 per cent. from the dilution of 10^{-2} to 10^{-8}. Seventeen per cent. of the mice survived the dilution of 10^{-10}. The embryo-cultured virus suspensions had a dilution endpoint of 10^{-7} that indicates a virus concentration which is considerably lower.

Those results are in perfect accord with the titration of the Venezuelan encephalomyelitis virus, which has in the mouse brain a titre oscillating between 10^{-6} and 10^{-8}, less frequently 10^{-10} to 10^{-12}. In the chick-embryo the average titre corresponds to the dilution 10^{-7} and is rarely higher or lower.

The immunological relation between the recently isolated virus from Trinidad and the Venezuelan encephalomyelitis strain virus (1938) has been studied in the protection test as follows: 72 Swiss mice have been immunized by means of 4 subcutaneous injections of 0.2 cc of the Venezuelan antiencephalomyelitis vaccine from chick-embryo cultured virus, one injection given every other day. The same vaccine has for many years been used with great success in combating encephalomyelitis in Venezuela. Three days after the last vaccination, the animals were divided into two batches for the challenge inoculation: the first group received intracerebrally 6 tenfold dilutions from 10^{-1} to 10^{-6} (using 6 mice for each dilution) of a mouse brain suspension containing Venezuelan encephalomyelitis virus, and the second one equal dilutions of the virus proceeding from Trinidad. Both viruses have been simultaneously titrated intracerebrally in non-immunized mice.

The vaccinated mice showed a solid protection against both viruses on test. The degree of immunity has been more or less equal against both of them, because the mice of each group withstood about 1,000,000 minimal lethal doses.

Summing up our findings, we believe we are entitled to draw the following conclusions:

(1) From 2 studied materials proceeding from a horse and a mule which died in Trinidad with clinical manifestations of encephalomyelitis, a neurotropic virus has been isolated.

(2) Inoculated into mice, guinea-pigs and chick-embryos, this virus showed the same properties as the Venezuelan equine encephalomyelitis strain virus.

(3) The vaccine prepared from Venezuelan chick-embryo cultured virus conferred on mice an equal protection against both viruses, the homologous as that of Trinidad.

(4) Therefore, an immunological identity between those two viruses is suspected.

Work on this theme is being continued.

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AN EXPERIMENTAL TEST OF THE THEORY THAT SOCIAL BEHAVIOR DETERMINES SOCIAL ORGANIZATION

IT appeared to the author that the fighting behavior of male mice of an inbred strain was suitable material for testing a fundamental theory of general sociology —that differences in social organization are caused by differences in social behavior. The strain used was subline 10 of the C–57 black, originally from the Jackson Laboratory at Bar Harbor. These mice have nearly identical heredity and can be depended upon to give similar reactions in similar environments.[1]

Preliminary experiments indicated that the males could be easily trained either to fight or not to fight. It was expected that if two fighting males were placed together they would develop some sort of social control or dominance based on fighting and that this organization would be absent between peaceful mice. This expectation was confirmed in the series of experiments described below, in which the mice were not only from the same inbred strain, but the same individuals were used for both fighting and non-fighting situations.

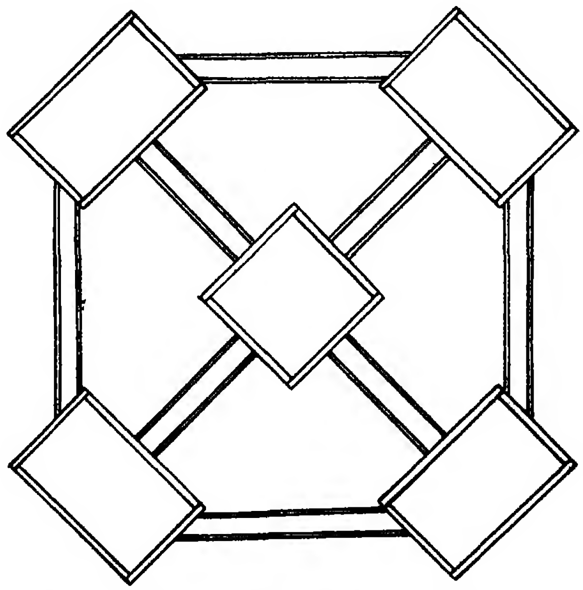

FIG. 1. Plan of multiple escape pen. The corner compartments are the same size as breeding boxes (10 × 15½"), and the entire top is covered with hardware cloth.

The mice were trained not to fight by the following method. A male and female of the same litter were raised in the same pen with no handling after weaning. Young were removed as soon as they appeared. After sexual maturity, as shown by the birth of young, the animals on at least three successive days were lifted out of the pen with forceps, roughly stroked five times and replaced. When another male, similarly trained, was put in the pen, no fight took place. The same result was obtained with each of six different pairs. The peaceful situation lasted as long as observation was continued (up to nine days; longer in

[1] J. P. Scott, *Jour. Heredity*, 33: 11–15, 1942.

preliminary work) without any fighting at the period of observation or any traces of injury at other times.

The apparent explanation is that the males are already inhibited against fighting the females. Since no fighting takes place after handling, they quickly associate not fighting with handling and are inhibited by the latter. There being no fighting at the first meeting, the inhibition probably tends to become permanent.

The same pair of males was then transferred to separate parts of a large multiple escape pen (planned as in Fig. 1) and isolated for at least fourteen days. Following the lead of Ginsburg and Allee,[2] who found that animals fought best if successful in fighting, these males were trained to fight by introducing a belligerent animal of the same strain and removing it before either mouse was hurt. This was done on at least five successive days. Immediately after the last training period the mice were allowed to enter each other's pens, this time without handling. A fight soon started, usually after one male had made a sexual attempt on the other, or had found the path to his home pen blocked. The result was that one of the males soon became the victor and chased the other round and round the two pens. This, a clear case of temporary social dominance based on fighting, was seen with each of the six pairs used.

The development of this organization was watched over a longer period after all other passages in the multiple escape pen were opened; the losing mouse is soon killed if left in the same small area. Each compartment had at least three avenues of escape, and only one mouse was killed while in the large pen. If the mice met while the observer was present, the winning mouse chased the other through the passageways, sometimes making several rounds but finally losing contact. This semi-permanent type of dominance was seen to persist as long as 33 days but gradually tended to die out unless training was repeated from time to time. In one case where a day elapsed between training and the first fight, fighting and dominance could only be reobtained by further training.

Here the explanation appears to be that the mice become conditioned to fight any mouse which the observer puts into the pen. After the first unchecked fight the winning mouse is conditioned to chase and and the loser to run away. When these responses are not reinforced by the introduction of a fighting mouse, they tend to die out.

The probability of getting such consistent results by chance is very small. These and consistent preliminary data make it highly probable that the theory of determination of social organization by social behavior is correct in so far as social dominance based on the fighting of male mice is concerned.

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[2] B. Ginsburg and W. C. Allee, *Phys. Zool.*, 15: 485–506, 1942.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A FLOWMETER FOR USE IN AIR SAMPLING PROCEDURES[1]

RECENTLY developed procedures for quantitative collection of air-borne bacteria and glycol vapors which utilize the Moulton atomizer sampler and the Folin aeration tube bubbler[2, 3, 4] depend upon accurate measurements of the air-flow. Most air flowmeters employ the Venturi or orifice principle by which the change in static pressure of an air stream during or after passage through a constriction is used as an index of the rate of air flow. The latter is defined in terms of unit volume of air per unit of time at standard conditions of atmospheric pressure and room temperature. The calibration of these flowmeters is usually carried out by connecting them in series with a standard instrument (wet gas-meter, spirometer bell, standard Venturi meter, etc.) so that these standard conditions are approximated.

It is not widely appreciated, however, that such flowmeters may give rise to erroneous air flow measurements when these standard conditions are not maintained. Flowmeters, connected downstream to a sampling device possessing high intrinsic resistance to the passage of air (*e.g.*, Moulton atomizer sampler) will give readings exceeding by as much as 70 per cent. the true rate of air-flow.[5] The actual value can be determined only by placing the flowmeter upstream to the sampling apparatus, where it will operate under conditions similar to those employed during calibration. Commercially available orifice flowmeters are usually unsuitable for use on the upstream side of air

[1] This investigation was aided in part through the Commission on Air-Borne Infections, Board for the Investigation and Control of Influenza and other Epidemic Diseases in the Army, Preventive Medicine Division, Office of the Surgeon General, U. S. Army.

[2] S. Moulton, T. T. Puck and H. M. Lemon, SCIENCE, 97: 51–52, 1943.

[3] H. Wise, T. T. Puck and H. M. Stral, *Jour. Biol. Chem.*, 150: 61, 1943.

[4] H. M. Lemon, *Proc. Soc. Exper. Biol. Med.* (in press).

[5] Downstream from a high resistance a considerable decrease in air pressure and therefore air density must occur; as a result a given mass of air will occupy a correspondingly increased volume. Compared with standard conditions, this air mass under diminished pressure must travel with increased velocity through the orifice if it is to pass through the meter in the same period of time, and hence an erroneously high static pressure difference will be observed.

sampling devices, since they may retain some of the material to be collected. Furthermore, they are expensive and fragile and their design is not adapted for sampling in locations difficult of access, such as air ducts.

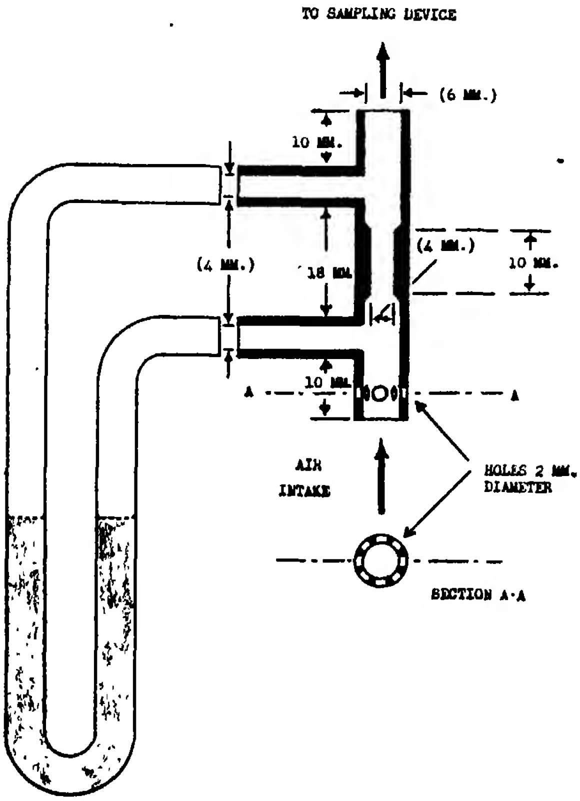

FIG. 1.

To avoid these objections the small flowmeter shown in Fig. 1 was developed. It is designed to be attached to the upstream end of any sampling device. A constricting orifice of 4 mm inside diameter and 10 mm length in a tube of 6 mm inside diameter and 48 mm in length will give a satisfactory change in static pressures for air-flows between 0.33 and 1.30 cu. ft. per minute. This change in static pressure is measured by a glass manometer (4–5 mm inside diameter and 120–150 mm long) filled either with water or a 1 per cent. solution of a suitable detergent with a few drops of phenol red added for coloring; the latter solution inhibits mold growth and improves the wetting of the glass. Graph paper ruled in millimeters backed by a wooden tongue depressor blade and bound to the manometer with transparent cellulose tape provides a simple scale. Any non-corroding metal or chemically inert plastic, such as Plexiglas, may be used in the construction of the flowmeter.

For calibration the flowmeter should be attached upstream to a standard wet-gas meter or a previously calibrated Venturi meter. The calibration curve shown in Fig. 2 has been reproducible within ±5 per cent. by either calibration method.

The eight 2-mm holes drilled 45° apart into the intake end of the meter maintain the static pressure

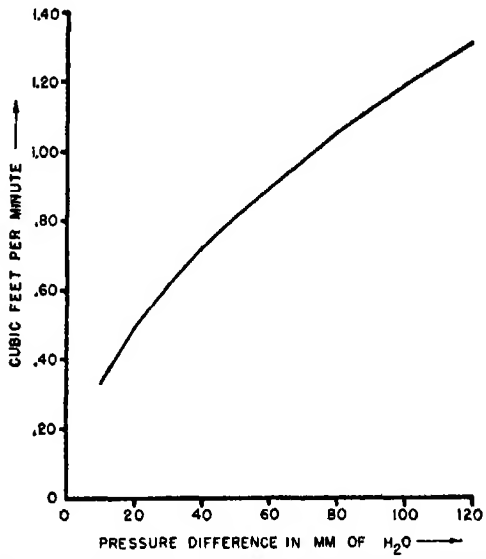

FIG. 2. Calibration curve for flowmeter (mean of 120 determinations) maximum deviation ±5 per cent.

difference within 1–2 mm of water for a given air-flow when the flowmeter is transferred from still to rapidly moving air;[6] without these holes a drop in pressure of 5–10 mm of water occurs.

It is especially designed for accurately measuring air-flows through the Moulton atomizer sampler and Folin aeration tube. Since it is readily cleaned, it does not interfere with determination of air-suspended microorganisms or glycol vapors. It is sufficiently compact and durable so that air samples may be taken in a wide variety of locations.

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[6] Velocities up to 2,500 ft./min.

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FEIGL, FRITZ. *Laboratory Manual of Spot Tests.* Translated from the German Manuscript by Ralph E. Oesper. Illustrated. Pp. xii + 276. Academic Press, Inc. $3.90.

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SOME MODERN CONCEPTIONS OF AMEBIASIS[1]

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Introduction

In 1875 a Russian physician, F. Lösch, first observed and described the active stage of *Endamoeba histolytica* in the dysenteric stools of a patient, and at necropsy found motile amebae in material obtained from ulcers of the colon. Moreover, he succeeded in infecting one of four dogs inoculated with amebae present in the bloody-mucous exudate of the patient. Yet Lösch failed to appreciate the role which his "Amoeba coli" played in the disease with which it was associated. The studies of Koch[2] and of Kartulis[3a, b] in Egypt, of Hlava[4] in Prague, of Osler,[5] Stengel,[6] Musser[7] and Dock[8] in the United States provided uncontestable evidence that the ameba discharged in dysenteric stools was causally related to amebic colitis, while Quincke and Roos,[9] Huber[10] and Schaudinn[11] demonstrated a cystic stage of the parasite. Meanwhile Councilman and Lafleur[12] had provided a basic pathological study of amebiasis and in 1913 Walker and Sellards demonstrated experimentally in human volunteers in the Philippines that the disease was produced by feeding cysts of *Endamoeba histolytica,* while infection without disease resulted from feeding cysts of *Endamoeba coli.* By 1924

[1] Alvarenga Prize Lecture of the College of Physicians of Philadelphia, delivered on October 13, 1943.

[2] R. Koch, *Wien. Med. Wochenschr.*, 33: 1248–1252; 1548–1551, 1883.

[3] a. S. Kartulis, *Arch. f. path. Anat.*, 105: 521–531, 1886; b. *Centralbl. f. Bakt. u. Parasitenkde.*, 2: 745–748, 1887.

[4] G. Hlava, *Zeitschr. d. böhm. Aerzte in Prag.*, 1887.

[5] Wm. Osler, *Johns Hopkins Hosp. Reports*, 1: 53–54, 1890.

[6] A. Stengel, *Med. News, Phila.*, 57: 500–503, 1890.

[7] J. H. Musser, *Univ. Med. Mag.*, Phila. 9 pp., 1890.

[8] G. Dock, *Med. Record*, N. Y., 40: 7–8, 1891.

[9] H. Quincke and E. Roos, *Berlin klin. Wochenschr.*, 30: 1089–1094, 1893.

[10] J. C. Huber, *Deutsch. Med. Wochenschr.*, 29 (Beih.): 267, 1903.

[11] F. Schaudinn, *Arb. aus d. kaiserl. Gesundh.-Amte*, 19: 547–576, 1903.

[12] W. T. Councilman and H. A. Lafleur, *Johns Hopkins Hosp. Reports*, 2: 395–548, 1891.

Boeck and Drbohlav[13] had perfected a technique for the *in vitro* cultivation of *E. histolytica* and by 1927 Craig[14] had demonstrated specific complement-fixing properties of *E. histolytica* antigen.

During this period of approximately fifty years the ideas that amebiasis was strictly or primarily a tropical disease and usually manifested itself as a fulminating dysentery or a liver abscess became gradually modified. Little by little, as epidemiologic studies were carried out, the discovery was made that amebiasis is practically cosmopolitan in its distribution, although as a rule its incidence is higher and its clinical expressions are more severe in the Tropics than in cooler climates. Dysentery and liver abscess were found to be only two of its more dramatic manifestations. There might be a history of an acute or subacute appendicitis or of general colonic distress without dysentery or even without diarrhea. There might be no apparent intestinal disturbance but a mild toxic state, with moderate leukocytosis and a low-grade fever. The patient might be considered symptomless by the uncritical diagnostician and yet at necropsy extensive amebic ulceration of the colon might be demonstrated. Throughout this period both by direct and indirect methods there developed increasing evidence that *Endamoeba histolytica* is always actually or potentially a pathogen and that it is capable of invading and destroying the host's tissue without the aid of pathogenic bacteria.

Hosts of Endamoeba histolytica

In addition to man the following hosts have been described as infected in nature or susceptible of experimental infection with *Endamoeba histolytica*—dogs, cats, monkeys, rats, pigs, guinea-pigs and rabbits.

Darling,[15] Ware,[16] Fischer,[17] Bausche and Motais,[18] Faust[19, 20] and Boyd[21] have described spontaneous amebiasis in dogs either in isolated instances or in epidemics among small groups of dogs. Lösch,[22] Hlava,[4] Harris,[23] Dale and Dobell,[24] Andrews,[29] Faust,[10, 20, 25, 26, 27, 28] Swartzwelder[30] and Tobie[31] have demonstrated the infectibility of dogs with trophozoites or cysts of human strains of *E. histolytica*. On the basis of previously published data and extensive personal observations Faust[26] concluded that dogs usually obtain their infection from man but do not constitute a normal source of exposure for human beings. The lesions in the dog may be few and superficial or extensive and deep-seated. The symptoms may be acute or chronic or spontaneous recovery may result after a short period of colonization by the amebae in the bowel wall. Occasionally liver abscess may develop following invasion of the intestine.

Many workers have infected kittens with human strains of *E. histolytica*. Among the more important investigators have been Marchoux,[32] Craig,[33] Wenyon,[34] Baetjer and Sellards,[35] Dale and Dobell,[24] Kessel,[36] Rees,[37] Meleney and Frye[38] and Deschiens.[39] Kittens develop a fulminating, frequently fatal amebic dysentery and are therefore excellent for acute experiments. There appear to be no records of their infection in nature.

Many species of Old and New World monkeys are naturally infected with strains of *Endamoeba histolytica* indistinguishable from those occurring in man. The incidence of natural infection in these animals is usually high, while experimentally induced infection with simian or human strains is easily accomplished. Although amebic invasion of the monkey's large bowel has been demonstrated[40] the parasite usually lives in relative equilibrium with its simian host so that acute symptoms seldom develop.

[13] W. C. Boeck and J. Drbohlav, *Am. Jour. Hygiene*, 5: 371–407, 1925.

[14] C. F. Craig, *Am. Jour. Trop. Med.*, 7: 225–240, 1927.

[15] S. T. Darling, *Proc. Canal Zone Med. Assn.*, 6: 60–62, 1915.

[16] F. Ware, *Jour. Comp. Path. and Therap.*, 19: 126–130, 1916.

[17] W. Fischer, *China Med. Jour.*, 32: 13–20, 1918.

[18] J. Bausche and F. Motais, *Bull. Soc. Path. Exot.*, 13: 161–165, 1920.

[19] E. C. Faust, *Proc. Soc. Exp. Biol. and Med.*, 27: 908–911, 1930.

[20] E. C. Faust, *Porto Rico Jour. Pub. Health and Trop. Med.*, 6: 391–400, 1931.

[21] J. S. K. Boyd, *Jour. R. Army Med. Corps*, 56: 1–13, 1931.

[22] F. Lösch, *Arch. of path. Anat.*, 65: 196–211, 1875.

[23] H. F. Harris, "On the Alterations Produced in the Large Intestine of Dogs by the *Amoeba coli*, by Heat and by Various Chemic Substances. Phila. 143 pp., 1901.

[24] H. H. Dale and C. Dobell, *Jour. Pharmacol. and Exp. Therap.*, 10: 399–459, 1917.

[25] E. C. Faust, *Am. Jour. Trop. Med.*, 11: 231–237, 1931.

[26] E. C. Faust, *Proc. Soc. Exp. Biol. and Med.*, 29: 659–661, 1932.

[27] E. C. Faust, *Jour. Pediat.*, 2: 53–58, 1933.

[28]a. E. C. Faust and E. S. Kagy, *Am. Jour. Trop. Med.*, 14: 221–233, 1934; b. 14: 235–255, 1934.

[29] J. Andrews, *Am. Jour. Trop. Med.*, 12: 401–404, 1932.

[30] J. C. Swartzwelder, *U. S. Pub. Health Reports*, 52: 1447–1451, 1937.

[31] J. E. Tobie, *Proc. Soc. Exp. Biol. and Med.*, 45: 691–693, 1940.

[32] E. Marchoux, *Compt. Rend. Soc. biol. Paris*, 51: 870–871, 1899.

[33] C. F. Craig, *Am. Med.*, Phila., 9: 854–861; 897–903; 936–942, 1905.

[34] C. M. Wenyon, *Jour. London School Trop. Med.*, 2: 27–, 1912.

[35] W. A. Baetjer and A. T. Sellards, *Johns Hopkins Hosp. Reports*, 25: 234–241, 1914.

[36] J. F. Kessel, *Am. Jour. Hyg.*, 8: 311–355, 1928.

[37] C. W. Rees, *Arch. Path.*, 7: 1–26, 1929.

[38]a. H. E. Meleney and W. W. Frye, *Am. Jour. Hyg.*, 17: 637–656, 1933; b. 25: 313–327, 1937.

[39] R. E. A. Deschiens, *Compt. Rend. Soc. biol. Paris*, 127: 939–941, 1938.

Pigs, guinea-pigs, rabbits and rats are probably incidental hosts of *Endamoeba histolytica* and in nature apparently play no important role as reservoirs of the infection.

SOURCES AND METHODS OF EXPOSURE TO INFECTION

On the basis of information concerning amebic infection in hosts other than man it must be concluded that man is primarily, in fact, almost exclusively responsible for his own infection. Although it has been demonstrated experimentally[22, 30] that infection in dogs can be accomplished by feeding the trophozoites in a bloody-mucous menstruum, it is hardly conceivable that this stage serves as a source of human infection. On the other hand, there is a wealth of records of infection in susceptible experimental animals, which, with the critical experiments of Walker and Sellards[41] on human volunteers, demonstrates that cysts constitute a ready source of infection, and that the method of their entry into the body is by the oral route.

In what way or ways do cysts of *Endamoeba histolytica*, discharged from the bowels of infected individuals, reach the human mouth? The most common hypotheses predicate water, food, flies and contact contamination. While each of these hypotheses fits well into the epidemiology of amebiasis, there is a paucity of direct proof for any one of them.

The *water hypothesis* is supported by circumstantial evidence, and hence indirect proof, in the case of the hyperendemicity of amebic dysentery in Manila and the Panama Canal Zone in the early days of American occupation, together with a marked diminution in the incidence and the intensity of the disease soon after the installation of sanitary water and sewerage systems in these localities. Moreover, the report of specialists in the 1933 Chicago hotel outbreak of amebic dysentery (Bundesen *et al.*)[41] concluded that drinking water contaminated by cross-connections with sewage pipes was responsible for the epidemic. One member of the investigating committee, the late Dr. F. W. O'Connor, lived in the hotel for one month, drank water from the faucet in his room and acquired amebic dysentery with amebic liver abscess. Although these are very important epidemiologic data, the fact remains that in none of these instances were cysts of *Endamoeba histolytica* reported to have been actually isolated from the contaminated water. Again, it is also plausible, but not confirmed, that shallow wells in rural areas may serve as a source of infection for the amebiasis which is widely disseminated throughout the Southeastern United States.

The *food hypothesis* is accepted by many epidemiologists as the most satisfactory explanation for the extensive distribution of amebiasis. In Oriental countries where truck crops and small fruits are fertilized with human nightsoil, it is conceivable that infection may be acquired from eating raw lettuce, celery, radishes and strawberries, provided fermentation of the nightsoil or desiccation of the cysts does not kill the cysts. A more likely contamination of food is that due to food handlers. Milam and Meleney[42] found a correlation between *E. histolytica*-infected mothers in rural Tennessee and familial amebiasis. Schoenleber[43] found that anti-amebic treatment of *E. histolytica*-positive food handlers on the island of Aruba, off the coast of Venezuela, reduced both the incidence rate of amebiasis and the amebic colitis rate 92 per cent. in three years. Surveys on food handlers in Chicago,[44] in San Francisco[45] and in Philadelphia,[46] have demonstrated a higher incidence of amebiasis in this group than in the population at large, but Sapiro and Johnson[47] found no evidence in navy personnel that food handlers constituted any particular hazard in the dissemination of the infection.

The *fly hypothesis* has not been given as great emphasis as the two views previously considered. In city populations essentially free of the dangers of filth flies this hypothesis obviously is not tenable, but in rural areas and throughout the Tropics and the Orient there is circumstantial evidence that flies may play the essential role in the rapid dissemination of the disease. Craig[48] attributed an epidemic of amebic dysentery in an Army post at El Paso, Texas, to flies. The writer made a similar observation in a foreign hill station in China during the summer of 1921. Moreover, amebiasis is particularly prevalent in fly-infested regions from Morocco to Peking. Thomson and Thomson,[49] Wenyon and O'Connor,[50] Roubaud,[51] Root[52] and Pipkin[53] have demonstrated viable cysts of *E.*

[40] C. M. Johnson, *Am. Jour. Trop. Med.*, 21: 49–58, 1941.

[41] E. L. Walker and A. T. Sellards, *Philip. Jour. Sci.* (*B*), 8: 253–331, 1913. H. N. Bundesen, J. I. Connolly, I. D. Rawlings, A. E. Gorman, G. W. McCoy and H. V. Hardy, *Nat. Inst. Health Bull.* No. 166, pp. 187, Washington, D. C., 1936.

[42] D. F. Milam and H. E. Meleney, *Am. Jour. Hyg.*, 14: 325–336, 1931.

[43] A. W. Schoenleber, *Jour. Trop. Med. and Hyg.*, 44: 41–43, 1941.

[44] M. Hood, *Am. Jour. Trop. Med.*, 23: 327–332, 1943.

[45] H. G. Johnstone and M. K. Iverson, *Am. Jour. Trop. Med.*, 15: 197–209, 1935.

[46] D. H. Wenrich, R. M. Stabler and J. H. Arnett, *Am. Jour. Trop. Med.*, 15: 331–345, 1935.

[47] J. J. Sapiro and C. M. Johnson, *Am. Jour. Trop. Med.*, 19: 255–265, 1939.

[48] C. F. Craig, *Mil. Surgeon*, 40: 286–302, 1917.

[49] D. Thomson and J. D. Thomson, *Jour. R. Army Med. Corps*, 27: 1–31, 1916.

[50] C. M. Wenyon and F. W. O'Connor, "Human Intestinal Protozoa in the Near East." London. 218 pp., 1917.

[51] E. Roubaud, *Bull. Soc. Path. Exot.*, 11: 116–171, 1918.

[52] F. M. Root, *Am. Jour. Hyg.*, 1: 131–153, 1921.

histolytica in both the gut and dejecta of flies after experimental feedings, while Frye and Meleney[54] found that flies caught in four of twelve dwellings which housed human cyst passers contained viable cysts of *E. histolytica*.

The *direct contact hypothesis* is probably applicable to a wide range of unsanitary situations in warm moist climates but in cooler climates may also apply, particularly to institutional groups, as children's asylums, mental hospitals and prisons. Outbreaks of amebic dysentery in prisons are much more frequent than the medical literature indicates. Mental hospitals have been found to be particularly afflicted with amebiasis from Panama[55] to Sweden,[56] and the infection has been found in children's homes from New Orleans to Saskatoon.[57] In New Orleans several children's homes and one infant asylum have been studied by the Department of Tropical Medicine of Tulane University since 1929. In all these institutions the incidence was found to be high, beginning with children slightly over one year of age and increasing rapidly to the period of adolescence (Faust).[27] Epidemiologic studies carried out at the infant asylum[57a] have demonstrated that identifiable cysts of *Endamoeba histolytica* were recoverable from the bottom of the laundry chute, from underpanties washed in tepid water, from play objects, floors and from the bottom of the children's wading pool. Although the place was apparently clean and the water supply was uncontaminated, a careful study of the habits of the children showed that direct contact contamination was prevalent. In certain mental hospitals and prisons the opportunities for gross transfer of amebic cysts from one individual to another are much greater than in the average children's home.

An examination of the evidence concerning the methods of exposure to amebiasis leaves much to be demonstrated. Without being hypercritical the student of scientific medicine will reserve judgment until more direct proof has been presented as to how in each situation amebiasis is actually perpetuated.

PATHOGENESIS

The stage of *Endamoeba histolytica* most likely to produce infection in man is the freshly ripened four-nucleate cyst, which is present in formed stools of infected individuals within a few hours after the stools have been passed. If these cysts gain entry to the mouth and are swallowed, they pass unmodified through the stomach into the small bowel. On arrival in a neutral or slightly alkaline medium of the latter the four-nucleate organism within the cyst wall becomes activated while the wall itself becomes weakened. This characteristically results in the ameba affecting an escape through a little rent in the wall. Thereupon a small amount of cytoplasm becomes associated with each of the four nuclei (or at times a supernumerary division of the nuclei may occur), with the result that four- or eight-minute metacystic trophozoites are formed. These trophozoites now pass down the remaining portion of the ileum, through the ileo-cecal valve and into the large bowel.

Stasis of material *en transit* through the intestine normally first occurs at the level of the cecum. If the metacystic trophozoites come in contact with the cuticula of the intestinal epithelium at this level for only a short time (probably measurable in minutes), they are enabled to establish a little "foothold," which constitutes their *entree* to tissue invasion. At times they may be swept past the cecum into the colon or rectum, where they may become attached, or perchance they may be passed out the anus in feces without having had an opportunity to make tissue contact.

The exact method by which the trophozoites establish themselves in the mucosa of the large bowel has been studied experimentally in dogs,[28] kittens[37, 58] and monkeys,[59] and is parallel in human amebiasis.[60] By lysis a very small cavity is produced in the superficial portion of a principal or gland cell. This may occur with equal likelihood at the tip of an interglandular prominence, part way down the crypt or at the base of the crypt. By continued lytic action, aided at times by mechanical activity of the pseudopodia, the ameba continues its invasion into the cell, utilizing the digested cell substance as food. Following growth, it multiplies by binary fission and thus a small colony becomes established. If these various factors are optimal, the colony may be formed within twenty-four hours or less after initial contact with the surface of the mucosa.

Once entry into the intestinal epithelium has been effected and the colony has started, the direction of tissue penetration and destruction is towards and through the muscularis mucosae. If lodgment was originally secured part way down a crypt, destruction of the superficial portion of the cells continues to the base. If the colony first became established at the base of the crypt, erosion of cells in this area occurs. In neither case do the amebae immediately

[53] A. C. Pipkin, *Proc. Soc. Exp. Biol. and Med.*, 49: 46–48, 1942.
[54] W. W. Frye and H. E. Meleney, *Jour. Parasitol.*, 18: 118, 1931.
[55] S. T. Darling, *Proc. Canal Zone Med. Assn.*, 4: (1), 41–47, 1911.
[56] R. M. Svensson, *Parasitol.*, 20: 237, 1928.
[57] M. J. Miller, *Jour. Parasitol.*, 25: 355–357, 1939.
[57a] G. L. Ivanhoe, *Am. Jour. Trop. Med.*, 23: 401–419, 1943.
[58] K. Hiyeda, *Am. Jour. Hyg.*, 12: 401–423, 1930.
[59] R. Hegner, C. M. Johnson and R. M. Stabler, *Am. Jour. Hyg.*, 15: 394–443, 1932.
[60] W. M. James, *Ann. Trop. Med. and Parasitol.*, 22: 201–225, 1928.

come in contact with intestinal blood capillaries and thus rather extensive destruction may occur in a limited area without hemorrhage. If, on the other hand, the original site of colonization was at the tip of an interglandular prominence, the amebae come in contact with blood capillaries as soon as they penetrate into the tunica propria below the epithelium, so that early hemorrhage results. In the average case the lesion progresses unhindered as a more or less capillary column until it reaches the muscularis mucosae where somewhat more resistant tissue is encountered. This causes a temporary pyramiding of the amebae, but soon some of them break through into the submucosa. There is now a tendency for the amebae to progress radially in this less resistant tissue, frequently gaining entrance into lymphatic capillaries and at times invading mesenteric venules. The usual result is the enlargement of the lesion basally in the submucosa, so that in section it is similar to a bottle with a narrow neck and expanded base. This is the typical uncomplicated amebic lesion.

At times in man, the monkey and the dog the lesion may be confined to the mucosa, in which case tissue destruction may be very superficial and spontaneous evacuation of the colony may occur with healing by growth of simple columnar epithelium.[31] Or repair may keep up with tissue destruction and only shallow microscopic depressions or craters will result.[61] In kittens much more intensive destruction usually occurs.

These uncomplicated amebic lesions are essentially different from those produced by *Shigella dysenteriae*. In primary amebiasis the sites of entry into the bowel wall are typically pinpoint and separated from one another, with a raised annulus surrounding each opening. There is little, if any, hyperemia or inflammation and microscopically there is no infiltration of neutrophiles. In bacillary colitis the surface of the bowel is hyperemic and inflamed and the lesions are confluent, while microscopically there is extensive invasion of neutrophiles. The amebic lesion is typically columnar in the mucosa but is continued into a bulbar base in the submucosa. The lesion of *Shigella* colitis rarely extends below the superficial half of the mucosa.

Once the characteristic bottle type of amebic lesion has been developed it may by extension reach the muscular coats of the bowel and even perforate through the serosa. Amebae which have secured entry into mesenteric venules in the submucosa and muscularis may be carried to the liver, where they may set up multiple small colonies (amebic hepatitis) or one or more large cavernous abscesses. Again, extensive colonization in the submucosa may result in undermining tunnels, with the junction of adjacent colonies and complete loss of arteriolar blood supply for the overlying tissues. Amebae extruded from primary lesions in the upper levels of the large bowel may by regurgitation be carried back to the posterior segment of the ileum or become lodged on the ileo-cecal valve where secondary lesions may develop. Or, perhaps more often, the organisms will pass down the bowel, come in contact with the mucosa at lower levels and there initiate secondary colonies.

In the average host parasitized by *Endamoeba histolytica* the majority of primary lesions occurs in the cecal area, including the cecum, appendix, the distal segment of the ileum and the ascending colon. The other focus of high frequency is the rectal area, including the sigmoid colon and the rectum. Even after numerous secondary lesions have been developed the cecal area still contains a preponderance of the total number of lesions.[61] Except in fulminating acute amebiasis or infections of long-standing the middle segment of the large bowel is only incidentally involved.

Although it has been demonstrated that bacteria are not necessary for successful entry of *Endamoeba histolytica* into the bowel wall,[62, 63] the older amebic ulcers are frequently complicated by bacterial invasion. Moreover, amebic colitis may be superimposed on a pre-existing *Shigella* colitis or *vice versa*.

It will next be useful to inquire into the chances of infection and of tissue invasion by *Endamoeba histolytica*. Infection is contingent on a number of factors which vary considerably under different conditions. First of all is the question of exposure. Qualitatively there must be viable organisms which have an opportunity of gaining entrance to the mouth and of being swallowed. On reaching the small bowel cysts must be capable of excysting. If the medium is too acid or the intestinal juices are too weak or are diluted too much by food in the process of digestion it is altogether likely that excystation will not occur and thus the cysts will pass through the large bowel and be evacuated without providing an opportunity for an infection to become established. Even though excystation occurs, if the number of metacytic trophozoites is scant the chances of their coming in contact with the cuticular surface of the epithelium of the large bowel are very remote, particularly if they are in the midst of a considerable menstruum of partly digested food or feces. Moreover, hypertonicity of the bowel is likely to carry the organisms through the bowel too rapidly for them to make temporary contact with the mucosal surface. Probably human beings in mildly endemic areas are often exposed to a few viable cysts which actually excyst in the ileum

[61] E. C. Faust, *Am. Jour. Trop. Med.*, 21: 35–48, 1941.

[62] E. C. Faust and J. C. Swartzwelder, *Proc. Soc. Exp. Biol. and Med.*, 32: 954–958, 1935.

[63] W. W. Frye and H. E. Meleney, *Am. Jour. Hyg.*, 18: 543–554, 1933.

but never have an opportunity to colonize in the bowel. On the other hand, in areas of hyperendemicity repeated exposure to large numbers of viable cysts provides the appropriate setting for development of heavy infections in a large group of the population.

The virulence of the particular strain of ameba also undoubtedly has considerable influence on initial colonization and continued tissue invasion. There is specific evidence based on experiments with human strains of *Endamoeba histolytica* in cats and dogs[38a, 62, 64] that different strains vary in their pathogenicity, but specific evidence is lacking in support of the view, predicated by Brumpt[65] and other European workers, that certain human strains of *E. histolytica* are nonpathogenic. An additional fact concerning this organism is significant, namely, that its virulence can be considerably enhanced by rapid passage through susceptible hosts.[38b, 62] This last property of the ameba may explain the rapidity with which an epidemic of amebic dysentery develops once heavy initial infection has been provided.

The factors thus far considered concerning opportunities for infection have been extrinsic in character and have not dealt with host susceptibility. Certain animals are undoubtedly completely resistant to infection with *Endamoeba histolytica*. In others, as the rat, there is suggestive evidence that colonization may possibly take place without the necessity of tissue invasion. On the other hand, in man, the monkey, the dog and the cat the evidence preponderates in favor of the view that infection can not be maintained for any length of time without tissue invasion. The kitten is a delicate test animal in amebiasis because it is highly susceptible to infection, the lesions develop rapidly and the infection is frequently fatal in a relatively short time. Monkeys are also readily infected with both human and simian strains of *Endamoeba histolytica*, but dysentery seldom results and typically only cysts are discharged in a semi-formed stool. In many respects the dog constitutes a particularly good laboratory animal for the study of amebiasis. If young dogs are properly conditioned for infection, at least 90 per cent. tissue invasion may be secured.[28, 31] In dogs the period of incubation can be shortened and the intensity of the infection can be increased by rapid passage of the organism from dog to dog.[62]

Thus, in the dog acute dysentery can be produced, comparable to that in the cat or to fulminating amebic dystentery in man. On the other hand, by appropriate technics the infection in the dog can frequently be transformed into a chronic state or at times terminated, even without the administration of specific anti-amebic drugs. Amebiasis in man varies both qualitatively and quantitatively. At times it resembles infection in the kitten; more frequently it simulates the infection in the dog; in the majority of cases, however, it is less severe and is comparable to simian infection.

Probably the most important single intrinsic factor which determines whether amebiasis in the susceptible animal is acute, chronic or relatively asymptomatic is the degree of host resistance based on the nutritional level. In general, carbohydrates provide an opportunity for *Endamoeba histolytica* to multiply, and animal proteins reduce this capacity,[66a, 66b, 67] but the problem is not so easily solved. In conditioning dogs for experimental infection with human strains of *E. histolytica* the writer found[19] that salmon and unfortified white bread provided a suitable low resistance diet for inducing and maintaining amebic infection, but that salmon alone was equally effective. Since these animals developed an anemia, it was important to discover if the cause was lack of the antianemic factor. Ventriculin exascerbated the condition, but fresh raw liver controlled it. Whole raw liver or freshly expressed juice of raw liver produced best results, providing amebostatic and at times amebicidal action.[28b] Moreover, fresh liver was much more effective than desiccated liver, while commercial liver extract or freshly extracted liver juice passed through a Seitz filter, when introduced parenterally, was ineffectual in controlling acute amebiasis, although both preparations stimulated erythropoiesis (Faust and Swartzwelder).[68] The most interesting finding in this series of experiments developed when finely ground-up fresh liver or fresh liver juice was employed as a high retention enema in dogs suffering from acute amebic colitis. The disease was as effectively controlled as when the fresh liver was fed to the animals.[28b]

Vitamins conceivably have a very important role in the control of amebiasis, but in so far as the writer knows this problem has not been subjected to critical experimental or clinical study.

An additional point in the evaluation of amebiasis in man concerns racial or group tolerance to the infection. There is no clear evidence indicating that race or sex is in itself important, but there are good epidemiologic data indicating that long exposure of a particular population group to strains of *Endamoeba histolytica* tends to establish a host-parasite equilib-

[64] W. W. Frye and H. E. Meleney, *Am. Jour. Hyg.*, 27: 580–589, 1938.

[65] E. Brumpt, *Trans. R. Soc. Trop. Med. and Hyg.*, 22: 101–114, 1928.

[66]a. R. Hegner and L. Eskridge, *Am. Jour. Hyg.*, 21: 121–134, 1935; b. *Jour. Parasitol.*, 23: 105–106, 1937.

[67] D. R. Lincicome, *Am. Jour. Hyg.*, 36: 321–337, 1942.

[68] E. C. Faust and J. C. Swartzwelder, *Proc. Soc. Exp. Biol. and Med.*, 33: 514–518, 1936.

rium for the homologous strains of the parasite. In such groups of human beings, even with constant exposure due to primitive sanitary conditions and a correspondingly high rate of infection with a heavy "load" of parasites, clinical manifestations are uncommon.[20, 38a, 69] Nevertheless, individuals from outside the hyperendemic areas who are exposed to the same strains of *Endamoeba histolytica* not uncommonly develop a fulminating amebic colitis. It appears, therefore, that long-time constant exposure to amebiasis tends to produce considerable tolerance to the amebae, with consequent reduction in invasion and in destruction of tissue.

(*To be concluded*)

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

ANTON JULIUS CARLSON

By Professor R. W. GERARD
UNIVERSITY OF CHICAGO, AND
Professor A. C. IVY
NORTHWESTERN UNIVERSITY

Time magazine, in its February 10, 1941, issue, placed the picture of Anton Julius Carlson on its cover and in the story called him "a Scientist's scientist." By popular vote of its 25,000 scientist members and by action of its council, the American Association for the Advancement of Science seems to have proven *Time's* assertion; for they have elected Dr. Carlson president of the association for 1944. Yet perhaps the designation is too narrow; Carlson is really the common man's scientist.

Few scientists of any period have been known so widely to the laity or have carried so variegated a load of civic, humanitarian and similar extra-curricular responsibilities. From the time of the last war, Carlson has progressively emerged from the confines of the laboratory to give freely of his time and effort and enthusiasm to serve the broad interests of science and education and to promote the intelligent application of these to human affairs. His skill as writer and speaker, his joy in a rough-and-tumble argument and his high scientific standing have placed him in great demand as lecturer, editor, adviser, legal expert, organizer, executive and plain fighter on "our" side—witness the joy of faculties all over the country when he, as president of the American Association of University Professors, was battling for them in "the den of deans."

Carlson's early boyhood was spent on the Swedish countryside. According to his own reminiscences, most of his time was devoted to herding goats. Surely the earthiness of the farmer was worn deeply into him: for to-day, after half a century in urban American life, there is little veneer over his directness of manner or simplicity of manners; just as he still says when excited, "It gives me the yim yams." Then followed a period as carpenter's apprentice in Chicago, which led to a denominational education at Augustana College and his placement as a minister in Montana. This phase also left its imprint, for Carlson's effectiveness as a teacher and protagonist is due as much to the evangelical zeal and revivalist's skill with which he presents his case as it is to the hard-headedness and logic of what he says.

Next came his long and passionate affair with science. It was love at first sight (of the writings of Jacques Loeb) and a stormy wooing and wedding. His first researches, one proving the neurogenic origin of the heart beat in Limulus and one showing a parallelism between the speed of action of a nerve and of the muscle it controls, were classics and soon brought him fame and his long-held position at the University of Chicago. Here, from 1904 to his retirement three years ago, he was first a member and then chairman of the department of physiology, teacher of a generation of scientists, a power on the campus and in national societies and an indefatigable worker. Here he, and his loyal colleague, Arno B. Luckhardt, performed studies on the stomach and hunger, on the whole digestive system, on the endocrines, on diet, on the lung, on all parts of the body.

Here he began his lecture schedule at seven in the morning and taught his daily way through classroom and laboratory until the mental scalps of his students were piled deep. He pulled no punches in his comments on their performance, and he was feared. But the kind heart below the rough tongue was also evident, and he was loved and followed.

World War I took Dr. Carlson (ending as Lieutenant-Colonel) to Europe and finally into Hoover's food rehabilitation group. The contact with starvation and other health problems, as well as the many intense experiences, launched Carlson into his next phase. He then threw himself into the national activities already mentioned. His recent commitments include, for example, the following: President of the Research Council on the Problems of Alcohol; the

Society for Experimental Biology and Medicine; the Union of American Biological Societies; the American Association of Scientific Workers, and the American Association of University Professors; Chairman or member of the editorial board of *Physiological Reviews;* the Board of Trustees, *Biological Abstracts;* the Committee to Promote Research on the Nature of Aging, National Research Council; the Public Advisory Committee, U. S. Public Health Service, and the Medical Advisory Committees of the National Foundation for Infantile Paralysis; Consultant to the U. S. Food and Drug Administration, and serving the Federal Trades Commission; the Office of War Information; the Aero-medical Service, and the Office of Price Administration.

But in whatever direction his bull-like energy and bull-dog determination are turned, whatever honors or obligations turn to him, Carlson remains the fearless, shrewd, self-reliant, feet-on-the-earth realist. Recently in Kansas, a mental telepathy enthusiast told how he suddenly felt at just nine o'clock one evening that his mother, in New York, needed him; and how he learned later that she had fallen down stairs that very evening at exactly nine o'clock. "And what," he said to Dr. Carlson, "do you think of that?" "My first thought," came the prompt response, "is of the hour difference between Eastern and Central time."

Dr. Carlson has long been known to his friends as Ajax. Every one thinks the nickname came from A. J.; but we know better. The name had to come, for was not Ajax the only heroic figure from the past who never called on man or God for aid, but always fought his own way out of trouble?

OBITUARY

EPHRAIM PORTER FELT
1868–1943

Dr. E. Porter Felt, widely known and respected in entomological circles for many years, died suddenly of a heart attack in his office at the Bartlett Tree Research Laboratories, Stamford, Conn., on December 14, 1943. Dr. Felt, the son of Charles Wilson Felt and Martha Seeth Ropes Felt, was born in Salem, Mass., on January 7, 1868. He graduated from the Massachusetts Agricultural College in 1891, and in 1892 and 1893 continued his studies at Cornell University under a fellowship, obtaining the degree of Sc.D. in 1894. During the years 1893 to 1895 he taught natural science at the Clinton Liberal Institute, Fort Plain, N. Y. In 1895 he was appointed assistant to Dr. J. A. Lintner, then state entomologist of New York, and following Lintner's death in 1898, he was made state entomologist, a position which he filled with distinction until his retirement in 1928. Following his retirement he became chief entomologist and director of the Bartlett Tree Research Laboratories, Stamford, Conn., where he continued his entomological work until his death.

As one of Professor John Henry Comstock's students at Cornell, Dr. Felt became one of the outstanding entomologists of the country. His annual reports of the state entomologist of New York are noteworthy entomological publications, and nearly every issue contains original contributions. Entomology was the center of Dr. Felt's life and activities. From 1898 to 1911 he was the entomological editor of the *Country Gentleman,* and when the *Journal of Economic Entomology* was started in 1908 he was its first editor, a position to which he was elected annually until his retirement in 1935, and in which he labored effectively for the good of entomology. Following the end of his active duties as editor he was elected honorary editor. In 1907 he was a member of the special commission for the study of the gipsy moth and brown-tail moth situations, inaugurated by A. H. Kirkland. The "Colcord Indexes to the Literature of American Economic Entomology," II to VI, were edited by Dr. Felt, the last one with the assistance of S. W. Bromley. In 1923 and 1924 he served as chief entomologist of the Gipsy Moth Bureau of the State Conservation Commission of New York, and for many years he was a member of the supervisory board of the American Yearbook Corporation. During the Pan-American Exposition at Buffalo, N. Y., in 1901, Dr. Felt was the honored recipient of one gold and three silver medals for his scientific contributions.

Dr. Felt was a fellow and an emeritus life member of the American Association for the Advancement of Science, a member of the Entomological Society of America, of which he was vice-president in 1916; the American Association of Economic Entomologists, of which he was president in 1902; and of its Eastern Branch; of the New York Entomological Society; of the Entomological Society of Washington and of the Cornell Chapter of the Society of the Sigma Xi. He was a constant attendant at meetings of national and regional entomological associations and shade tree bodies and gave freely of his time and knowledge to policy-making committees.

His scientific contributions run into hundreds of titles, many of them dealing with descriptions of new species of Itonididae. He was particularly interested in gall-producing insects, and his "Key to American Insect Galls" (N. Y. St. Mus. Bull. 200, 1918) and his later book "Plant Galls and Gall Makers" (Ithaca,

N. Y., 1940) are widely used. Many of his publications deal with insects injurious to trees, and all entomologists are familiar with his two-volume work entitled "Insects Affecting Park and Woodland Trees" (Mem. 8, N. Y. St. Museum, 1905–6), with its numerous excellent illustrations and colored plates. In 1924 the Macmillan Company brought out his "Manual of Tree and Shrub Insects." For many years he was interested in the dispersal of insects by air currents and published several papers on this subject. Although never wavering from his interest in entomology, during his last years he published extensively on the care of trees, as witnessed by his books on "Pruning Trees and Shrubs," "Our Shade Trees" and "Shelter Trees in War and Peace," all brought out by the Orange Judd Company as part of their Farm and Garden Library.

In addition to his life-long interest in gall insects and in shade tree insects, Dr. Felt was concerned with the major insect pests of the eastern United States, and always participated in conferences dealing with their control. In addition he was a frequent speaker at entomological gatherings and before groups interested in the care of trees. His entomological interests were varied and his writings, both scientific and popular, were always thoughtful and sound. During his busy and complete life he contributed extensively to the advancement of entomology in this country. Always affable and willng to share his information, Dr. Felt was liked and admired by every one and the familiar figure of this slender, scholarly gentleman will be missed at many future entomological gatherings. The paths of many scientific workers are made easier by the industry of a few, and Dr. Felt was one of the few. Dr. Felt was married in 1896 to Helen Maria Otterson, who died in 1939. He is survived by a son and three daughters.

H. B. WEISS

RECENT DEATHS

DR. THOMAS SCOTT FISKE, emeritus professor of mathematics at Columbia University and for thirty-five years secretary of the College Entrance Examination Board, from which he retired in 1936, died on January 10. He was seventy-eight years old.

RAY T. STULL, chief of the heavy clay section of the National Bureau of Standards, died on January 5 at the age of sixty-eight years.

DR. JOHN CARL BELTZ, research chemist of the U. S. Bureau of Mines, Washington, D. C., died on January 10 at the age of forty-seven years.

DR. BENJAMIN WESLEY KILGORE, state chemist of North Carolina, died on January 3 in his seventy-seventh year. He was formerly director of the North Carolina Agricultural Experiment Station and of the Extension Service and dean of the College of Agriculture of the North Carolina State College.

DR. JOHN S. FONDA, assistant director of sales of the Grasselli chemicals department of E. I. du Pont de Nemours and Company, died on December 22. He was forty-six years old.

DR. WILLIAM P. FRASER, emeritus professor of biology of the University of Saskatchewan, formerly chief of the Dominion Laboratory of Plant Pathology at Saskatoon, died on November 23 at the age of seventy-six years.

SCIENTIFIC EVENTS

SURVEY OF THE AMERICAN FORESTRY ASSOCIATION

AN appraisal has been initiated by the American Forestry Association of the effect of the war on the forest resources of the country so that post-war reconstruction and problems of forest management and land economy may be dealt with on a factual basis. The survey has the support and cooperation of state and federal forestry agencies and the forest industries. It will be completed, it is estimated, in from two to three years. John B. Woods, of Portland, Oregon, an authority on timber valuation, formerly forester for the Lumber Code Authority under the National Industrial Recovery Act, will direct the survey. He will be at the head of a staff of well-known specialists in forest appraisal and will be assisted by an advisory council of five members prominent in state and federal forestry, forest industry and in agriculture.

Members of this council are: William G. Howard, of Albany, New York, director of Lands and Forests, New York State Conservation Department; James W. Girard, of Washington, D. C., Division of Forest Economics, U. S. Forest Service; William B. Greeley, of Seattle, Wash., a former chief forester of the United States, now secretary-manager of the West Coast Lumbermen's Association; S. T. Dana, dean of the School of Forestry and Conservation of the University of Michigan and editor of the *Journal of Forestry;* and E. O. Siecke, Wisner, Nebr., farmer and veteran forestry leader in Texas and the South.

The main objective of the appraisal is to provide information for the handling of local, state and national postwar forest and land-use problems. According to Ovid Butler, executive secretary of the association, a forest appraisal consultant will be appointed in each of the principal forest regions of the country. With a state as a study unit, they will inventory forest

land conditions and appraise the effects of war on the forests. Assurances of active cooperation have been given by state forestry departments and other state, regional and federal agencies. Lines of study to be followed include recapitulation of forest and farm woodland surveys—inventory of timber-growing stock and forest lands; ownership and management of forests by federal, state and private classifications—land, timber and other forest values; extent and character of forest drain since 1940; utilization trends, with particular attention to wartime uses and peacetime possibilities; marketing of forest crops; public attitudes toward forest resources and industries; permissible postwar drain—silvicultural, quality and other economic factors; scope and effectiveness of forest legislation with reference to protection, perpetuation and utilization of forest resources; and ownership problems and trends—local and federal taxes.

THE TORREY BOTANICAL CLUB

Dr. Charles Thom, of the Bureau of Plant Industry, U. S. Department of Agriculture, spoke on December 7 before the Torrey Botanical Club. His subject was "A Mycologist Looks at Antibiotics, especially Penicillin." A hundred and fifty members and guests gathered at Columbia University to hear his address.

The annual meeting and banquet were held at the Men's Faculty Club of Columbia University on January 4. Colonel Arthur F. Fischer, known for his flight from the Philippines with several million seeds of high-yielding quinine plants, gave the address. Colonel Fischer was introduced by the retiring president, Dr. William J. Robbins. The following officers were elected to serve in 1944:

President, Dr. Michael Levine, Montefiore Hospital.

1st Vice-president, Dr. Fred J. Seaver, New York Botanical Garden.

2nd Vice-president, Dr. H. K. Svenson, Brooklyn Botanic Garden.

Corresponding Secretary, Dr. Edwin B. Matzke, Columbia University.

Recording Secretary, Miss Honor Hollinghurst, New York City.

Treasurer, Mrs. John S. Karling, New York City.

Editor, Dr. Harold W. Rickett, New York Botanical Garden.

Bibliographer, Mrs. Lazella Schwarten, New York Botanical Garden.

Business Manager, Dr. H. H. Clum, Hunter College.

Members of the Council: Dr. Lela V. Barton, Boyce Thompson Institute; Dr. E. H. Fulling, New York Botanical Garden; Dr. J. S. Karling, Columbia University; Rutherford Platt, New York City.

Delegate to New York Academy of Sciences, Dr. B. O. Dodge, New York Botanical Garden.

Representative on Board of New York Botanical Garden, Dr. H. A. Gleason, New York Botanical Garden.

Representatives on the Council of the American Association for the Advancement of Science: Dr. J. H. Barnhart, New York Botanical Garden; Dr. A. F. Blakeslee, Smith College.

LECTURES ON MEDICAL EDUCATION

A series of six lecture discussions on "The Relation of Medical Education to the Practice of Medicine of the Future" are being held at the New York University College of Medicine on successive Monday evenings at 5 P.M. The first lecture was given on January 17. Representatives of medical foundations, medical and liberal arts colleges, public health services and professional committees are taking part.

Dr. Alan Gregg, medical director of the Rockefeller Foundation, opened the series with a paper entitled "Looking to the Future." Discussion was led by Dr. Walter B. Cannon, of Harvard University, who was recently appointed visiting professor at the New York University College of Medicine, and Dean Willard C. Rappleye, dean of the College of Physicians and Surgeons of Columbia University.

Lecturers at future meetings will include Dr. Leonard Carmichael, president of Tufts College; Dr. Joseph W. Mountain, assistant surgeon general, U. S. Public Health Service; Dr. Louis Hamman, associate professor of medicine of the School of Medicine of the Johns Hopkins University; Dr. Franz Goldman, associate clinical professor of public health of the School of Medicine of Yale University; and Dr. A. D. Macdonald, dean of the Medical School of the University of Manchester, England.

Discussion leaders will include Dr. Elmer J. Butler, professor of biology, Princeton University; Dr. Harry S. Mustard, director, DeLamar Institute of Public Health; Dr. Michael M. Davis, chairman, Committee on Research in Medical Economics; Dr. Jean A. Curran, president and dean of the Long Island College of Medicine, and Dr. Homer W. Smith, Dr. Henry E. Meleney, Dr. William S. Tillett, Dr. S. Bernard Wortis, Dr. Evan W. Thomas and Dr. R. Keith Cannan, all of the faculty of the New York University College of Medicine.

The sessions will be presided over by Dr. Harry Woodburn Chase, chancellor of the university.

GRANTS-IN-AID OF THE PERMANENT SCIENCE FUND OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES

Income from the Permanent Science Fund, by agreement and declaration of trust, is disbursed by the American Academy of Arts and Sciences in support of "scientific research in the fields of mathematics, physics, chemistry, astronomy, geology, geography, zoology, botany, anthropology, psychology, sociology and economics, history and philology, engi-

neering, medicine, surgery, agriculture, manufacture and commerce, education or any other science of any nature or description."

Applications for grants-in-aid are receivable on forms which will be supplied upon request by the chairman of the committee, and will be considered by the committee of award on March 1, June 1 and October 1.

It is stipulated that title to equipment purchased outright from a grant from the Permanent Science Fund resides in the fund, such purchased equipment being subject to reassignment by the committee upon termination of research in the particular field of endeavor in support of which a grant is made.

It is further a condition of grants made by the academy from the Permanent Science Fund that they are not for financial support of work the results of which comprise partial fulfillment of requirements for an academic degree.

It is a policy of the committee not to approve requests for general permanent equipment for institutions.

Communications should be addressed to John W. M. Bunker, *Chairman,* Permanent Science Fund Committee, Massachusetts Institute of Technology, Cambridge 39, Massachusetts.

THE COMMONWEALTH FUND AND MEDICAL RESEARCH

According to the official summary of the twenty-fifth annual report of the Commonwealth Fund for the year ending September 30, 1943, the fund has contributed directly to undergraduate and graduate teaching in medicine by subsidizing departments of preventive medicine and psychiatry at medical schools, by offering advanced fellowships to instructors chosen by their department heads as potential leaders in medical education and by financing interschool visits by outstanding medical teachers. It has just begun a six-year schedule of grants to the Long Island College of Medicine for the development of its department of psychiatry.

Medical research has taken more and more of the fund's income. Of the $4,000,000 appropriated for this purpose in 25 years, nearly a tenth was distributed in the fiscal year ended October 30, 1943, when aid was given to 41 investigations at 11 university schools of medicine and 8 other institutions of similar scientific standing. War medicine plays a large part in current research. Studies of kidney and respiratory function, long aided by the fund because of their physiological importance, have made important contributions to the understanding of shock, now a crucial military problem, and grants have been made specifically for work of military significance in aviation medicine and the control of infectious disease. The three grants made this year for work not previously supported included one to the University of Pennsylvania, for a study by Dr. Max B. Lurie of physiological factors responsible for differences in susceptibility to tuberculosis; one to Washington University, for a study by Dr. W. Barry Wood, Jr., of recovery factors in certain types of pneumonia; and one to the New Jersey Agricultural Experiment Station for Dr. Selman A. Waksman's investigation of new substances derived from molds or fungi which, like penicillin, might be useful in the control of disease agents.

For the past two years fellowships have been offered to Latin-American physicians and public health workers for postgraduate study in the United States. Under this plan three men from the Argentine Republic, two each from Brazil, Uruguay and Venezuela, and one each from Chile, Colombia, the Dominican Republic, Ecuador, Haiti and Honduras hold appointments for the current academic year. Awards are made with the cooperation of the Pan American Sanitary Bureau. According to the report, these Latin-American fellows "are well-trained, energetic, eager to improve themselves, and almost without exception are either holding or preparing to hold positions of responsibility in public health and clinical medicine."

SCIENTIFIC NOTES AND NEWS

The Charles P. Daly Medal of the American Geographical Society of New York has been awarded to Sir Halford John Mackinder, the English geographer and statesman, and the Cullum Geographical Medal to Arthur Robert Hinks, secretary of the Royal Geographical Society, London. Presentation of the medals will be made in London later in the winter. Sir Halford served as reader in and professor of geography at the University of London from 1900 to 1925 and as member of Parliament and chairman of the Imperial Economic Committee from 1926 to 1931. Mr. Hinks has been secretary of the Royal Geographical Society since 1915. Honorary corresponding memberships in the society have been awarded to Dr. Christovam Leite de Castro, secretary-general of the National Council of Geography of the Brazilian Institute of Geography and Statistics, and to Señor Manuel Medina, chief of the Geographical Office of the Ministry of Agriculture and Development of Mexico.

William H. McAvoy, chief test pilot of the National Advisory Committee for Aeronautics, has been

chosen as the recipient of the Octave Chanute Award for 1943 of the Institute of Aeronautical Sciences, in recognition of "continuous service in the flight-testing of experimental airplanes under hazardous conditions imposed in aeronautical research." The presentation will be made on January 24 at the honors night dinner of the institute at the Hotel Waldorf-Astoria.

THE Bailey K. Ashford Award was presented at the Cincinnati meeting of the American Society of Tropical Medicine to Norman H. Topping, passed assistant surgeon of the U. S. Public Health Service, National Institute of Health, Bethesda, Md., in recognition of his "outstanding work in the field of tropical medicine." In 1941 he went to La Paz, Bolivia, to study the effects of a typhus vaccine developed at the Rocky Mountain laboratory of the U. S. Public Health Service at Hamilton, Mont.

ERNEST B. BABCOCK, professor of genetics at the University of California at Berkeley, and Dr. William H. Chandler, professor of horticulture at the University of California at Los Angeles, have been named faculty research lecturers for 1944. They will lecture on the subject of their researches during charter week from March 19 to 25.

A HUNDRED and twenty letters from professional associates and friends from all over the country were bound and presented on December 20 to Dr. Oswald Schreiner, at a meeting in his honor at the station of the Bureau of Plant Industry of the U. S. Department of Agriculture at Beltsville, Md. Dr. Schreiner, who joined the Bureau of Soils in 1903 and became later chief of investigations in soil fertility, retired on December 31 after serving for forty years.

THE award of the League of Fraternal and Benevolent Organizations of the Jewish Education Committee of New York was made at a luncheon given on January 9 to Dr. Arthur H. Compton, professor of physics at the University of Chicago, for his "effective promotion of justice, amity, understanding and cooperation among the peoples of all creeds in our beloved land and in other lands." Dr. Compton, who was unable to be present at the luncheon, sent a telegram accepting the award.

THE University of Delaware recently conferred upon Thomas Hamilton Chilton, of the E. I. du Pont de Nemours and Company, the honorary degree of doctor of science in recognition of "his distinguished achievements in the province of chemical engineering and his invaluable personal contribution to the welfare of that institution."

RESULTS of the election of officers of the Genetics Society of America for the year 1944, carried out by postal-card ballot in the absence of an annual meeting, are announced as follows: *President*, Professor A. H. Sturtevant, California Institute of Technology; *Vice-president*, Dr. B. P. Kaufmann, Carnegie Institution, Cold Spring Harbor; *Secretary-treasurer* (for a term of three years), Professor L. H. Snyder, the Ohio State University. The executive committee of the society for 1944 will include Professors E. W. Lindstrom, the Iowa State College, and M. M. Rhoades, Columbia University, presidents in 1942 and 1943.

THE officers for 1944 of the American Society for Horticultural Science are: *President*, Dr. Warren P. Tufts, University of California, Davis; *Vice-president*, Dr. Warren B. Mack, Pennsylvania State College, and *Secretary-Treasurer*, Dr. H. B. Tukey, Experiment Station, Geneva, N. Y.

DR. WALTER B. CANNON, emeritus professor of physiology at Harvard University, has been elected president of the newly founded American-Soviet Medical Society. Dr. Henry E. Sigerist, director of the Institute of the History of Medicine, the Johns Hopkins University, has been appointed editor of its journal, *The American Review of Soviet Medicine*.

OFFICERS elected for 1944 by the American Association of Textile Technologists are Lieutenant William F. Macia, *President;* Carl I. Taber, *First Vice-president;* Pierre Sillan, *Second Vice-president;* Ralph Gutekunst, *Treasurer*, and Bernice S. Bronner, *Secretary.*

DR. FERDINAND J. M. SICHEL has been promoted to an associate professorship of physiology at the College of Medicine of the University of Vermont.

DR. R. MENDEZ, instructor in pharmacotherapy at the Harvard Medical School, has been appointed assistant professor of pharmacology at the Loyola University School of Medicine, Chicago. He will assist Dr. A. S. Marrozzi, who is chairman of the department of pharmacology.

DR. J. A. SHELLENBERGER has resigned his position as technical adviser to the Corporacion para la Promocion del Intercambio, S. A., at Buenos Aires, which is sponsored by the Government of Argentina, to accept an appointment as professor of milling industry at the Kansas State College. He expects to return to this country late in February.

Nature reports that the title of professor of technical optics in the University of London has been conferred on Dr. L. C. Martin in respect of the post held by him at the Imperial College of Science and Technology.

GEORGE I. QUIMBY, JR., assistant curator of North American ethnology at the Chicago Natural History

Museum, has been promoted to be curator of exhibits in the department of anthropology.

J. VICTOR SKIFF has been appointed to the post of Deputy Conservation Commissioner of New York State to succeed John L. Halpin, who is resigning from the department as of January 31.

R. A. BOYER, of the Ford Laboratory at Dearborn, Mich., has become director of scientific research with The Drackett Company, Cincinnati, Ohio. He is continuing his work on soybean fiber.

BASIL A. PLUSNIN has been appointed forester of the 8,000-acre forest of Yale University in Tolland and Windham Counties, Connecticut.

PROFESSOR ORA S. DUFFENDACK, since 1922 a member of the faculty of the University of Michigan, has resigned to accept a position in private industry with the North American Philips Company of New York City. He will organize and direct a new research staff and laboratory for which he will be given a free hand in selecting both research fields and staff members. He will sit in on the board of directors of the company. For the past two years he has been chief of a research section of the National Defense Research Committee in the Randall Physics Laboratory of the university. He expects to continue to supervise this work.

DR. CARL L. A. SCHMIDT, dean of the College of Pharmacy of the University of California, has leave of absence for the last half of the present academic year to enable him to complete researches in biochemistry in which he is engaged. Dr. Troy C. Daniels, assistant dean and professor of pharmaceutical chemistry, has been appointed acting dean.

DR. LEO L. CARRICK, dean of the School of Chemical Technology, North Dakota Agricultural College, has been appointed consulting chemical engineer and director of the research on red lead being carried out by the Lead Industries Association of New York City.

DR. OSCAR NEUMANN, formerly ornithologist of the Berlin Museum, said to have been one of the last Jewish refugees to be able to escape from Germany, is now working at the Chicago Natural History Museum.

DR. WILLIAM DUNCAN STRONG, professor of anthropology at Columbia University and director of the Ethnographic Board of the Smithsonian Institution, gave an address on January 20 before the Washington Academy of Sciences entitled "Recent Anthropological Research in Latin America." This was the forty-sixth annual meeting of the academy.

IT is announced that the American Medical Association will hold its annual meeting from June 12 to 16 in Chicago. The House of Delegates will meet in the Palmer House, where the scientific exhibit and the opening general meeting will also be held. The registration bureau and the technical exhibits will be in the Hotel Stevens, and the meetings of the various sections will be assigned to these hotels and in addition to the Hotel Sherman and the Morrison Hotel.

AN appraisal of the estate of Edward S. Harkness, who died in 1940, shows that he left $54,000,000 more to be divided among educational, charitable and religious organizations, some of which he helped to establish. He had given away in his lifetime more than $120,000,000. Mr. Harkness left his residuary estate in trust for the benefit of his widow, Mary Stillman Harkness. Upon her death the charities will share the principal of her trust. One half will go to the Commonwealth Fund, a foundation established in 1918 by Mrs. Stephen S. Harkness.

ACCORDING to the will of Edgar Palmer, who died last January, Palmer Square, now three-quarters completed, which consists of the Princeton Inn, a theater and several other buildings, is bequeathed to Princeton University. He also gave a laboratory valued at $750,000 in addition to the $1,000,000 Palmer Stadium. His will carries a provision that should his daughter die leaving no children, $1,000,000 of the $2,000,000 left in trust for her should go to the trustees of the university.

ALBERT H. SCHMIDT, of Detroit, has given to the Board of Education of Wayne University the sum of $10,000 to assist in establishing an agricultural school at a farm now owned by the board near Novi, Mich., to be known as the Albert H. Schmidt Foundation. The project is to be developed and conducted by Wayne University. He has indicated that it is his intention ultimately to leave substantially his entire estate to further the project. In addition to providing educational opportunities for boys from 14 to 18 years of age, the school will provide a research center in the natural and physical sciences related to the development of agriculture. Although the new institution will be supported in part by revenues derived from the students, it is expected that a major part of its income will be obtained from the sale of farm produce, from funds to be provided by Mr. Schmidt and from other resources which the Board of Education may use for the development of the school. It is anticipated that the produce of the farm will be used in the cafeterias of the Detroit Public Schools.

THE late Dr. Russell Henry Chittenden, formerly professor of physiological chemistry and director of the Sheffield Scientific School of Yale University, bequeathed his scientific library to the university and a trust fund of $3,000, the income of which is to be used for a prize to be known as the Russell H. Chittenden Prize, to be awarded at commencement to the

member of the graduating class who stands highest in his class at the Sheffield Scientific School.

GIFTS to Columbia University, aggregating $44,770, have been announced, to be used largely to finance research in medicine, chemistry and allied sciences and to support work in other fields. The larger gifts include $24,200 from the John and Mary R. Markle Foundation in support of a study of the chemotherapy of filariasis; $5,000 from the Lederle Laboratories, Inc., to be credited to the Bell gift for enzyme chemistry in the department of medicine, and $4,000 for dietary research from Swift and Company.

Chemical and Engineering News reports that the Howes Publishing Company has endowed an Olney Medal to be awarded by the American Association of Textile Chemists and Colorists "to afford public recognition of outstanding achievement in the field of textile chemistry" and as a testimonial to Louis Atwell Olney, president emeritus of the association and chairman of its research committee, in recognition of his lifetime of devotion and contributions to this field. The candidate receiving the award will be selected by a committee of five members of the association.

THE Library of the U. S. Department of Agriculture is now issuing a monthly Bibliography of Agriculture, which will organize all the information in current agricultural literature, regardless of the form of the publication or the language in which it was originally published. The number of titles listed each year is expected to exceed 50,000.

THE first issue of the *British Journal of Industrial Medicine* is to be published in January, 1944, under the editorship of Dr. Donald Hunter. It will appear quarterly. Its headquarters are at the British Medical Association House, Tavistock Square, London, W.C. 1. Editorial communications should be sent to Dr. Hunter at the London Hospital.

THROUGH Dr. John D. Long, of the Pan American Sanitary Bureau of Washington, who recently visited Uruguay, the Government of the United States has offered a donation of $500,000 to Uruguay for improvements in public health. Uruguay will contribute an additional fund of $100,000 for the same purpose. The work will be carried on by American and Uruguayan specialized technicians.

DISCUSSION

VITAMER OR ISOTEL? BOTH?

IN the issue of SCIENCE for October 29, Dr. Roger J. Williams criticized the choice of the word "vitamer" to "designate vitamin forms that can replace one another."

Rather, I believe, the word vitamer was coined to represent just what its root words mean, life-part, that part of the diet of any animal that performs the same function, regardless of the fact that quite different chemical entities may be required in different species to perform this specific effect that the vitamer under discussion is characterized for.

That is a separate purpose than that for which Dr. Williams suggests the term "isotel." An isotelic vitamin or food factor would be, according to his definition, a factor that can replace another in a given diet or nutrient media, for some specified species, or under a given set of circumstances. Evidently, we are in need of both terms to accurately express ourselves in dealing with the situation we are confronted with.

Vitamer A, accordingly, is that factor in any nutrient system that provides the vitamin A effect. It may be carotene for one species, kryptoxanthin for another, vitamin A_1 in salt water fish, vitamin A_2 for fresh. But for the human species, carotene is isotelic with vitamin A, for carotene can be converted into vitamin A in the human, thus can replace it in the diet of this specific species. Carotene, for the human species, therefore, would be isotelic with vitamin A. In the case of the cat, however, which can not make this conversion, carotene is not isotelic with vitamin A. A list of the vitamin A isotels for the cat would not include this factor.

The A vitamers for the cat are the isotelic substances that afford the nutritive effect of vitamin A for the cat. If the cat can only make use of one substance, there are then no vitamin A isotels for the species, but there always would be a vitamer A for any species that requires that vitamin in any form.

The term vitamer is just as hypothetical as the term carbohydrate or protein. A carbohydrate is that portion of the diet that supplies energy. It may be starch for the human, cellulose for the rabbit. Cellulose is not isotelic with starch for the human organism, but it is for rabbits and ruminants.

As cobalt and manganese are isotelic in their effect of activating enzymes, this term may be found representative for probably all classes of food factors, whether simple or complex. Vitamers, however, seem to be representative of the more complex food factors. Such of the vitamins as are found conjugated with proteins in foods seem to be relatively specific for species. The pellagra preventive vitamer is a good example.

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CLARASE INACTIVATION OF PENICILLIN

DR. C. A. LAWRENCE reported in SCIENCE (98, 413, 1943) that penicillin could be inactivated by clarase (standardized) as a preliminary step toward the sterility test for penicillin. The writer had been unsuccessfully attempting to do the same thing with a sample of clarase (standardized), when the above-mentioned report was published. Two samples of clarase (regular) and one of clarase (standardized) were secured and, together with some regular clarase already in the laboratory, comparative tests were made.

The 4 per cent. solution of clarase was made in a buffer of pH 5.2 and passed through Seitz filters to sterilize it. This was then tubed aseptically and stored in the refrigerator. The sodium salt of penicillin was dissolved in sterile distilled water to give approximately 20,000 units per milliliter. Two milliliters of this penicillin solution were then mixed with 2 ml of the 4 per cent. clarase solution being tested and placed in a waterbath at 40° C.

This experiment was repeated three times with different lots of penicillin, and the same results were obtained each time. Out of five samples tested, only one (regular clarase No. 1351) completely inactivated 9,000 units of penicillin in six hours but not in four. A sample of the same batch (No. 1351) subsequently received reduced the titer from 10,000 units to approximately 200 units in six hours. The other samples (regular clarase No. 1466, standardized clarase No. 1339, standardized clarase No. 1104 and an unnumbered batch of regular clarase) were essentially inactive, giving no appreciable inactivation of penicillin in 24 hours. All samples of clarase were secured from Takamine Laboratory, Inc., Clifton, N. J.

If clarase is to be used for the inactivation of penicillin prior to the sterility test, each lot must be tested and certified for this particular activity.

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CENTRALIZATION OF PERSONAL RECORDS

ALTHOUGH the nation periodically surveys its industry, commerce and agriculture, and once each decade tabulates its population, it is only in time of war that an exhaustive inquiry is made into its human resources. Even in time of war, the group examined constitutes only a small percentage of the total population.

Many physicians, psychologists, biometricians and physiologists long have felt the need for the centralization of medical and other personal records. Such records would be held in strictest confidence, and would be available only to licensed physicians, authorized public agencies and those qualified in scientific research.

Special forms might be designed for the recording of data. The analysis of such forms would bring under scientific scrutiny the life careers of 135,000,000 human guinea pigs. The data collected would include the complete medical history of the individual from birth to date. His medical record would follow him wherever he went, and would be made available to the physician of his choice. Every physician would be asked or required to file periodic reports on his patients. The assembled records might also include fingerprints, intelligence ratings, family history, education, work history, special skills, hobbies and other pertinent information. Such a project would provide us with invaluable material concerning the nation's most precious resource, namely, human beings.

Material gathered in the course of the war well might serve as a nucleus for such a collection of data. The records would be retained permanently, perhaps for generations, and would be assembled at strategic locations throughout the country. Such records should exist for the entire population.

At the present time, although a tremendous fund of health and other personal data exists, it is not being fully utilized. Much of it is being destroyed by schools, physicians and by the individual himself. The material which survives is often so scattered and so deeply buried that it is of no practical value. Some of the benefits which would derive from the adoption of the proposed plan include:

(1) It would improve medical treatment and facilitate diagnosis. Individuals often change their physicians, either because of choice or necessity, and hence there is no continuity in the medical history. It is well known that patients frequently are unable to provide their doctors with accurate case histories. This is an important handicap in medical practice.

Knowledge of the course of a disease has much to do with its proper management. Complete records would eliminate unnecessary duplication and would bring to light conditions which the busy physician could not determine without a great deal of work. Such records would definitely improve the quality of medical practice and would save time and money.

(2) It would make available to public health agencies a source of important leads with regard to public health work. It would improve our control of communicable disease. It would give us the most accurate picture of the public health and of public health needs that we ever have had.

(3) It would contribute to the national security and to our military effort, by showing us the availability of our human resources for uniformed or indus-

trial duty or for other activities in the national interest. It would do for the nation what the National Roster of Scientific and Specialized Personnel has done for some of the professions. It would enable us to plan our educational program more intelligently, and to correct remediable health defects in those who must be the backbone of any military effort we may be called upon to make.

(4) It would provide an almost limitless source for research in genetics, longevity, disease, human behavior and a hundred other fields. From the systematic study of such data would come leads and discoveries of tremendous value to science, and, ultimately, of tremendous benefit to the individual. Such a reservoir of data would have a thousand and one uses, many of which we to-day can not even foresee.

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EDITORIAL CHANGES IN SCIENTIFIC PAPERS

DR. WILLIAM C. BOYD (SCIENCE, August 27, 1943) complains of editorial changes whereby a substantive modifying a noun (in his manuscript) becomes an adjective modifying a noun (on the printed page).

Probably the most important factor in the impairment of English speech to-day is the fallacy that parts of speech may be connected without the use of connectives. Without knowing what journals are under criticism, it may be safely conjectured that the editors have, as a safeguard, wisely established a style which will permit this malady (a noun modifying a noun) to be treated both in its early and in its acute stages, where (with apologies to Gert. Stein) a noun modifies a noun modifies a noun modifies a noun. More rigorous and more intelligent editing would have prevented the following expressions, all of which recently appeared in print: "rudder control mechanism sequence," "material control shortage group," and "instrument approach procedure summary."

The first cited instance of Dr. Boyd's displeasure is the editorial change of "horse serum" (which is ambiguous) to "equine serum" (which is unmistakably clear). "Horse serum" may mean serum *for* the horse, serum *from* the horse, or serum *of* the horse, just as the widely used expression "Consumer research" may mean research *by* the consumer, research *concerning* the consumer, or research *for* the consumer. The argument that the man who elects to read any material will understand which one is meant is not a valid one. How do we know? Surely one of the most important functions of language is to convey information to the uninformed, and the language of science should be written not only so that it can be understood, but so that it *can not be misunderstood.* In attaining this end, proper editing will continue to be of great value.

E. H. MCCLELLAND

CARNEGIE LIBRARY OF PITTSBURGH

SCIENTIFIC BOOKS

RADIO AND ELECTRONICS

Experimental Electronics. By RALPH H. MILLER, R. L. GARMAN and M. E. DROZ. New York: Prentice-Hall, 1942.

Principles of Radio. By KEITH HENNEY. 4th Edition. New York: John Wiley and Sons, 1942.

Principles of Electronics. By ROYCE G. KLOEFFLER. New York: John Wiley and Sons, 1942.

Elements of Radio. By ABRAHAM MARCUS and WILLIAM MARCUS under the editorship of RALPH E. HORTON. New York: Prentice-Hall, 1943. $4.00.

Fundamentals of Electricity. By LESTER R. WILLIARD. New York: Ginn and Company, 1943.

RADIO and electronics have permeated every branch of our war effort. The production of electronic equipment for the armed forces alone is several times the normal peace-time production. The dissemination of war information makes the maintenance of home radio receivers and the broadcast stations an industry essential to the prosecution of the war. In addition, war industries, from gasoline refineries to ordnance manufacturers, have found this new tool, electronics, so valuable in reducing man hours that the development and manufacture of such apparatus is being carried on under the highest priorities. The vacuum tube is no longer only the bulb in the parlor radio. It has gone to war. We find it by the guns and in the factory.

People from many walks of life are finding that they must learn of the electron tube and its applications. The chemical engineer finds it controlling his processes. The power plant engineer finds it increasing the efficiency of his boilers. The foreman of the manufacturing plant finds it used as a tool on his production line. The airplane manufacturer finds it molding his fuselage and wing parts. The shipbuilder finds it in his welding operations. The ordnance officer finds it throughout his equipment. The naval officer and the air force officer would be lost if it failed.

These applications of the electron tube have shown the need for personnel trained in the field of radio and electronics. The present scarcity of trained personnel is requiring the employment of many persons who are unfamiliar with even the basic principles

of electronic circuits. Many in positions of responsibility are finding that they must dig in and learn something of this field if they are to avoid being surpassed by progressive youngsters.

Training in this subject is different from mathematics or any such standard subject. Except for a negligible number of specialists, it has been omitted from the training of all who now need it, from the Ph.D.'s training as well as from the high-school course. However, the individual with a mathematical and scientific training may be expected to learn the subject in an entirely different manner from that adopted by the high-school boy. The electrical engineer would be in a different class from the naval architect. The trainee who is to become an electronic design specialist should approach the study in a different manner than the trainee who needs a brief course to learn to maintain a particular type of equipment or the trainee who needs a survey course to determine possibilities of electronics in a new field.

The books included in the above group are five of the many recent books on radio and electronics, each intended to train persons who have a particular type of background to fill some position among the varied electronic applications or to start along the road toward a thorough training in the field. Because of the varied character of the training needed, none of these books compete directly with each other. They each have their own special zone of application.

"Fundamentals of Electricity," by Williard, is written for use in training in high school. Upon finishing this course together with the courses regularly taken by the high-school student, the trainee will have a background upon which he can build a thorough training in any of the many branches of electricity. It fits nicely as the first course in electricity for the boy who will continue in one of the several vocational training courses in electricity. Its use as a basic pre-induction training for the several technician ratings in the Army is quite natural. The specialized training given to these men in the Army itself is far more satisfactory when it is preceded by a general course in the basic fundamentals of electricity.

"Elements of Radio," by Abraham Marcus and William Marcus, is written specifically for the person with an avid interest in learning about radio. In this book each section is started by posing a question such as that asked by the beginner in radio or describing a phenomenon with which the student is undoubtedly familiar. Then follows the process of leading his thoughts, bringing him up against a barrier which he can cross only by learning the fundamentals of electricity. This process may be expected to fan the waning interest of the bored student, causing him to continue with his study. The book is to be recommended to those who start studies enthusiastically but fail to continue when the study approaches drudgery.

"Principles of Radio," by Henney, is in its fourth edition in a little over a decade. That shows definitely that it has been well received. This book has been very popular as the text in vocational training in radio. It is very good in this field and is to be recommended for the radio student who has recently studied his high-school algebra and trigonometry. It is necessary for the student to have a working knowledge of algebra. With this background the student using this book gets a far more thorough understanding of radio than with either of the two preceding books. The student after completing one of the above books might well continue his studies with this as a text.

"Principles of Electronics," by Kloeffler, leaves the subject of radio to other texts, presenting the general principles and devices involving the flow of electricity through mediums other than solids. Various devices involving such flow together with circuits using these devices are discussed. The uses of electronics are covered very briefly. For instance, radio receivers and transmitters are treated in four and a half pages. The book is definitely designed for engineers. While it is written for an introductory survey course in electronics for prospective students of electrical engineering, it seems best adapted for the graduate engineer who completed his studies before electronics was introduced into the curriculum and now finds that subject necessary. It may be criticized for being too condensed even as a short survey. Where the subject must be condensed to this extent, this book fits the bill admirably.

"Experimental Electronics," by Muller, Garman and Droz, is written specifically for research workers who find electronics necessary as a laboratory tool. The book is a laboratory manual for use in an extensive laboratory course. Such a course is an ideal training for the scientific experimentalist. However, the book's usefulness is not limited to the role of accompaniment with many hours spent in the electronics laboratory. The experiments are discussed and described so adequately and the sample results are set forth so completely that experimenters experienced in reviewing reports of laboratory work hardly need to see the experiment performed in the laboratory to fully visualize the apparatus and its operation. The book may be advantageously used by such workers, even though they intend to carry out very few or even none of the experiments specified. It should be strongly recommended for the research worker who expects or hopes to use electronic devices in his laboratory.

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SPECIAL ARTICLES

ABSENCE OF AUDIOGENIC SEIZURES IN WILD NORWAY AND ALEXANDRINE RATS[1]

NUMEROUS observers[2, 3] have reported that loud sounds of high frequency have a profound effect on the behavior of rats. They produce in the rats a high state of excitement characterized by wild undirected running and culminating in a convulsive seizure. In all instances the rats were of the common Norwegian variety which have been bred and raised under laboratory conditions for many generations. It occurred to us to determine whether wild rats taken directly from their native haunts would also show these convulsive seizures when exposed to loud sounds of high frequency.

Opportunity to make these observations came incidentally to other studies on a large number of wild Norway and Alexandrine rats which were trapped alive in alleys, cellars, yards, factories and granaries. Essentially the same technique of auditory stimulation was employed as in previous experiments on the production of convulsive seizures in the domesticated rat. Air-blast, key jingling and air-driven Galton whistle served as stimuli. One hundred and twenty-six wild Norway rats and fifteen wild Alexandrine rats were tested. Stimulation periods were of five minutes duration, with three minutes rest interposed between the different stimuli. In most instances, the rats were tested within a few days after being trapped, but in a few cases they were not tested for several weeks. Seven of the wild Norway rats were selected at random and subjected to daily auditory tests for a period of 27 days.

None of the wild Norway or Alexandrine rats showed either the preliminary high states of excitement or the culminating convulsive seizures; nor did they show any fear responses such as retreats from the hissing air-blast, a common reaction of the domesticated rat to this form of stimulation. On the contrary, they exhibited definitely aggressive behavior in attacking and attempting to bite the metal nozzle of the air-blast apparatus.

The most obvious explanation of the absence of audiogenic seizures in the wild rat is that the convulsions may be a characteristic of domestication. In agreement with this explanation Farris and Yeakel[4] have reported that wild Norway rats bred in the laboratory for 19 generations showed an even greater susceptibility to seizures than their albino relatives. It is evident that if the wild rat showed any such response in its natural environment it would not survive very long.

Some of the factors which may influence the appearance of fits under conditions of domestication are: (1) the progressive inbreeding of a sensitivity to sounds of high frequency; (2) dietary deficiencies produced by the laboratory stock diets; (3) the effects produced by confiement in small cages; (4) the lack of practise in meeting new situations; and (5) endocrine changes.

That dietary factors may play an important part we know from the fact that domesticated rats which never before manifested audiogenic seizures show them when placed on a diet deficient either in magnesium,[5] thiamin[6] or pyrodoxine.[7] It is quite possible that many of the stock diets fed domestic rats may be deficient in one or more of the minerals and vitamins which are essential for prevention of convulsive seizures. Some of our studies indicate that Purina dog chow, which is widely used as a stock diet, is deficient in thiamin. It was found that domestic rats on this diet showed the audiogenic seizures with great regularity, but failed to exhibit them when allowed to drink freely from bottles filled with a solution of thiamin chloride. In regard to the wild rats, it may be pointed out that despite their life in burrows, in alleys, yards and cellars, they may actually have a wider and better assortment of foodstuffs, especially of minerals and vitamins found in the earth, than their domesticated brothers and sisters raised in modern laboratories. In trapping several thousand rats we have found them in general to be strong, vigorous and free from signs of dietary deficiency, such as loss of hair, dermatitis, poor teeth, etc., often in spite of heavy infestation with internal parasites.

Some evidence at hand indicates that the lack of experience in meeting new situations may play an important part in the production of seizures in the domestic rats. These rats, bred for many generations in the sheltered environment of laboratory cages, have long been deprived of the opportunity or necessity of meeting and adjusting quickly and adequately to new situations. Wild rats, on the contrary, owe their very existence to their ability to react adequately to constantly changing situations encountered in their environments, and in so doing have developed strong patterns of aggressive behavior. Consequently, the laboratory-bred animals would be more disposed to conflict and breakdown in the presence of novel situations than their wild relatives.

The importance of being able to make any kind of

[1] Aided by a grant to Curt P. Richter from the Committee for Research in Endocrinology.

[2] C. T. Morgan and J. D. Morgan, *Jour. Comp. Psychol.*, 27: 505, 1939.

[3] F. W. Finger, *Am. Jour. Psychol.*, 55: 68, 1942.

[4] E. J. Farris and E. H. Yeakel, *Jour. Comp. Psychol.*, 35: 73, 1943.

[5] H. D. Kruse, E. R. Orent and E. V. McCollum, *Jour. Biol. Chem.*, 96: 519, 1932.

[6] R. A. Patton, H. W. Karn and C. G. King, *Jour. Comp. Psychol.*, 32: 543, 1941.

[7] H. Chick, M. M. El Sadr and A. N. Worden, *Jour. Biochem.*, 34: 595, 1940.

a response to the experimental situation is brought out by the observation that domestic rats show the fits with less regularity when allowed to run back and forth between the main cage and a small adjoining cage, even though the sound stimulus still follows them.[8] In the wild rat the strong aggressive behavior may serve as an energy outlet or a buffer, which prevents the organism from reaching an explosive level.

Whatever the reason for the absence of auditory fits in the wild rats and their presence in the tame domestic rats we have here an interesting example of behavior differences caused by domestication.

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CHANGES IN ACID-SOLUBLE PHOSPHORUS COMPOUNDS IN THE BRAIN IN POLIOMYELITIS[1]

UNTIL very recently the study of chemical and metabolic pathology of the central nervous system in poliomyelitis was entirely neglected. Racker and Kabat[2] demonstrated that the brain tissue of mice infected with poliomyelitis virus showed a decreased rate of anaerobic breakdown of glucose while oxygen consumption was unimpaired. Recent metabolic studies[3] suggest that this change is specific for poliomyelitis and is not produced by other neurotropic viruses. A decreased lactic acid content of the brain in poliomyelitis has been reported.[4]

The present paper is a preliminary report on changes in acid-soluble phosphorus compounds in the brain in poliomyelitis.

Swiss albino mice four to six weeks of age were infected by intracerebral inoculation of poliomyelitis virus of the Lansing strain. When definite paralysis appeared, the mice were sacrificed by immersion in a mixture of solid CO_2 and ethyl alcohol. Normal mice were treated in a similar manner. The mice were stored in a dry ice box for from several days to two weeks and then the brains were carefully removed. Three brains were pooled for each determination to make a total weight of tissue of approximately one gram. Phosphocreatine, adenosine triphosphate and residual organic phosphate were determined by the method of Stone.[5]

The results are presented in Table I. It is evident that there are marked changes in these compounds in poliomyelitis: adenosine triphosphate increases, while phosphocreatine and residual organic phosphate decrease. The value for adenosine triphosphate for normal mouse brain is similar to that reported by Stone[5] while his normal values for phosphocreatine and residual organic phosphate are somewhat higher than those in Table I. Despite considerable variation, the differences between poliomyelitic and normal brain are clearly significant statistically by use of the "t distribution."[6]

TABLE I

THE EFFECTS OF POLIOMYELITIS ON ACID-SOLUBLE PHOSPHORUS COMPOUNDS OF THE MOUSE BRAIN*

	Phosphocreatine	Adenosine triphosphate	Residual organic phosphate
	NORMAL		
	10 8	16.3	23.2
	10.6	14 8	22.2
	9.40	17 9	22.3
	10.5	20 0	22.84
	2 1	17 5	5.2
	6.65	17.1	9.45
	6.83	15.9	25.97
Mean	8.13	16.05	18.74
	POLIOMYELITIS		
	5 55	23.9	0.80
	1 38	28.0	3 20
	2.38	26.5	7.47
	0.63	24.0	2.50
	0.46	22.1	4.14
	5 83	32.7	0 90
	4 50	33 3	1.11
	5 68	15 0	13.32
Mean	3 44	25 71	4 18
t	3.28	3.65	4.5
Per cent. change from normal	−56.0	+51 7	−77.6

* P per 100 grams of brain tissue

The changes in acid-soluble phosphorus compounds observed in the brain in poliomyelitis can not be explained on the basis of greater autolysis in the infected tissue, since autolysis would decrease rather than increase the adenosine triphosphate content.[5] The intracellular parasite, the virus, might, in the course of its growth and multiplication, break down nucleoproteins of the cell or might interfere with dephosphorylation of adenosine triphosphate to produce an increase of the latter compound in the brain tissue. The marked changes in acid-soluble phosphorus compounds suggest the possibility of a considerable interference with energy mechanisms and carbohydrate metabolism of the neurons by the virus infection.

Summary: Preliminary studies indicate that the content of adenosine triphosphate is greatly increased in the brain of the mouse infected with poliomyelitis virus. On the other hand, phosphocreatine and residual organic phosphate are markedly decreased in the infected brain.

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[8] W. J. Griffiths, *Comp. Psychol. Monog.*, 17: 1, 1942.

[1] Aided by a grant from the National Foundation for Infantile Paralysis. The author is at present with the Division of Chemotherapy, National Institute of Health, Bethesda, Maryland.

[2] E. Racker and H. Kabat, *Jour. Exp. Med.*, 76: 579, 1942.

[3] M. Nickle and H. Kabat. Unpublished observations.

[4] H. Kabat, D. Erickson, C. Eklund and M. Nickle, SCIENCE (in press).

[5] W. E. Stone, *Jour. Biol. Chem.*, 135: 43, 1940.

[6] F. E. Croxton and D. J. Cowden, "Applied General Statistics." New York: Prentice-Hall, Inc., 1940.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

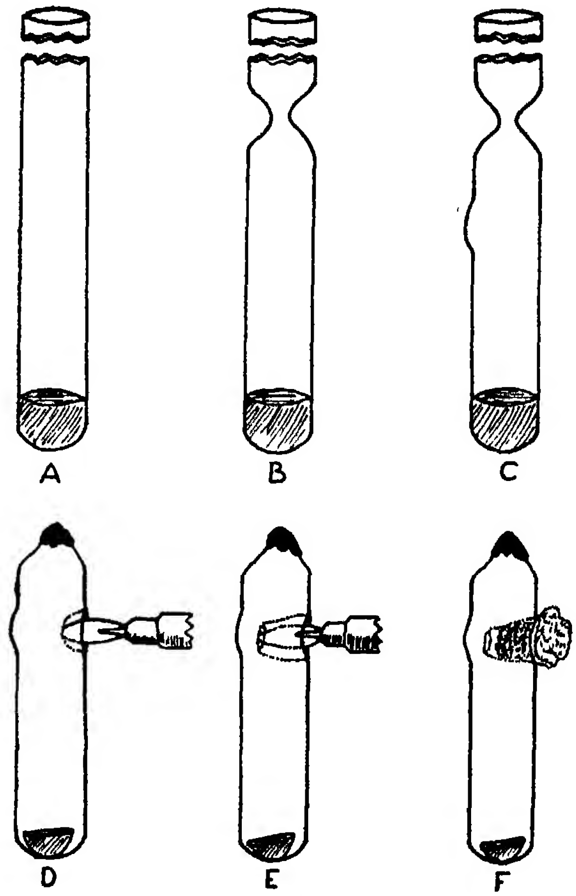
A METHOD OF OPENING LYOPHILE TUBES

THE difficulty of conveniently and cleanly breaking open vacuum-sealed tubes of dried material led to the development of the following method of preparing, sealing and opening tubes having a diameter of 1.5 cm. The method is undoubtedly applicable to tubes of other dimensions.

The material to be dried is placed in a sterile Pyrex test-tube, 15 cm by 1.5 cm (A), and the cotton plug is pushed about one inch into the tube. The tube is then heated and constricted about 7 cm from the bottom (B). Using a spot flame, a small cup is blown about 2 cm below the constriction (C), and the tube is then attached to the lyophile apparatus. After the material has been thoroughly dried, the tube is sealed at the constriction and the tip is dipped in sealing-wax to prevent entrance of air if scoring of the sealed tip should occur.

When it is desired to open the tube, a spot flame (gas-oxygen) is applied opposite the cup (D) and the vacuum causes atmospheric pressure to force an inverted bubble into the lumen of the tube. The size of this bubble is controlled by rotating the flame. When a suitable diameter has been obtained, the flame is directed toward the point where the break is desired. With proper direction of the flame, the bubble elongates and finally breaks toward the cup (E). The flame is then removed, and a sterile cotton plug is inserted into the "funnel" (F). This procedure for opening the tube requires about ten seconds.

Theoretically, the air which rushes into the tube through the break is sterile, since, at that time, the walls of the funnel are very hot and the flame is still in place. To test this, the following trials were run. Five tubes, each containing a small agar slant, were treated by this procedure and, after opening, were plugged with cotton and placed in an incubator at 37.5° C. No growth had occurred at the end of one week. Five tubes containing a suspension of a rapidly growing bacillus, and two tubes containing a suspension of *Mycobacterium tuberculosis avium* were all lyophiled and opened as above. Sterile distilled water was pipetted through the funnels into the tubes and the dried material resuspended. The tubes were then tilted horizontally so that the suspension flowed into the cups, and a loop of material was removed from each tube and streaked on agar slants. Growth without contamination occurred on all slants. Two series of ten tubes each, one containing anti-bovine-brucellosis-serum and the other containing anti-swine-brucellosis-serum, both antisera being of known titer, were lyophiled and sealed. Half of the tubes in each series were opened by the regular method of scoring and breaking, and the other half were opened by the method herein described. Upon determining the agglutination titers of the redissolved material, no difference was noted among the various samples.



A noticeable advantage is the fact that the cotton plug is protected by the glass walls of the funnel, and only unusual handling will cause the fluid in the tube to come in contact with the cotton.

A. APPLEBY

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AGRICULTURAL RESEARCH ADMINISTRATION

BOOKS RECEIVED

DAVSON HUGH and JAMES FREDERIC DANIELLI. *The Permeability of Natural Membranes.* Illustrated. Pp. x + 361. Cambridge University Press. $4.75.

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SCIENCE IN THE U.S.S.R.

SOVIET BIOLOGY[1]

By Dr. L. C. DUNN
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AT the time of the tenth anniversary of the October Revolution in 1927, I was in Moscow; I awakened each morning in the little glass-sided cupola on top of the palatial and elegant mansion which had now become the Institute of Experimental Biology. My first impression was one of familiarity, of at-homeness, for this was a genetics laboratory, filled with the sights and smells associated with the little fly, Drosophila, which breeds in its thousands in the milk bottles of fermenting food which line all the genetics laboratories in the world. But in the farther distance, through the windows, were the spires of Moscow, and these and the physical world they represented were utterly strange and new to me.

[1] **Address at the Science Panel of the Congress Celebrating the Tenth Anniversary of American-Soviet Friendship, New York, November 7, 1943. The complete proceedings of the Science Congress including the Medical Session will be published at a later date by the National Council of American-Soviet Friendship.**

This alternation of strangeness and familiarity must have struck many American visitors to Russia, and it persists when we try to examine the scientific achievements of the Soviet Union or indeed of any country not our own. For any modern science is in some sense the same wherever we find it, a part of one interconnected whole resting on common basic principles, with a common past and a common future, and it is artificial and deceptive to try to break it into separate national entities. And yet, just as the history of science consists in part of the achievements of individuals, so also it rests on the contributions of groups of persons with common purposes and common methods, and oftentimes the character of these groups is determined by the physical, economic and social milieu. It was unquestionable that the society behind Soviet biology was very different from that found in Europe and America, and this, together with the temperament, traditions and outlook of the Soviet scien-

tists lent a distinctly Russian flavor to their joint work. There was too a kind of revolutionary tinge about their manner of approach to some of the problems of biology. Whereas Westerners were inclined to go in through the traditional front door, our Soviet colleagues seemed at times to break in through the back door or even to come up through the floor.

Thus it comes about that it is possible to speak of "Soviet" biological research and to single out for comment a few of its characteristics. I should like it understood that I do this from a very limited knowledge of Soviet biology which covers a vast field and that I can speak with confidence only about work which is closely related to my own field.

The qualities in Soviet biological research which have struck me most are first, from the purely scientific side, its vitality and activity, and the atmosphere of eagerness, modernity and novelty which has surrounded it. To the outsider looking in it has had aspects of youth and originality which have never attached, for example, to the scientific renaissance which was taking place at about the same time in Japan. In the second place, one Westerner at least has noted the peculiar and almost paradoxical combination of philosophical and theoretical impetus with which practical purposes are pursued. On the organizational side, the peculiarity of Soviet biology is of course that it is centrally planned and administered, chiefly through the Academy of Sciences, that its purpose is not only to discover new knowledge but to penetrate the whole life of the community. It is thus of very great scope both with regard to the numbers of persons engaged in it and in its institutional and geographic connections.

The great vitality of Soviet biology is nowhere better evidenced than in my own field of genetics and its close relative, cytology. Here there is no doubt that the most important contributions have been coming from the U. S. A. and U.S.S.R., and in the number of workers, of institutes and in quality of work these two countries are comparable. Genetics has been recognized in Russia as one of the disciplines underlying agriculture and medicine and has received a large measure of support. Professor Koltzoff, director of the Institute of Experimental Biology in Moscow, told me of how he traveled to Leningrad during the famine of 1920 with Lenin and some other members of the Central Executive. Lenin was to urge upon the responsible committee the diversion of some of the funds set aside for famine relief to the construction of a research institute for seed selection and plant breeding. "The famine to prevent," said Lenin, "is the next one and the time to begin is now." He carried his point and there was built with emergency funds the great Institute of Applied Botany which under the direction of Nikolai Vavilov became the center of the greatest plant breeding and seed selection service in the world. Vavilov himself became the world authority on the history of crop plants.

In 1921 also the American geneticist, H. J. Muller, took to Moscow strains of the vinegar fly *Drosophila* and there grew up the greatest center of theoretical research in this field outside of the United States. Although the impetus came from America, the Soviet workers soon took their own line, and there was founded under Tschetverikoff the important new field of population genetics for the study of the distribution of new hereditary characters in nature. In the hands of Dubinin, Timofeef-Ressovsky and Dobzhansky, the latter now in the United States, this developed into the most important new experimental approach to the problems of evolution. Out of Soviet genetics have come also new ideas of chromosome structure, of the origin of mutations and new ideas on the arrangement and relations of the hereditary particles, the genes, by very many workers. By 1940 Moscow had in fact become one of the most important centers of work of this kind.

The comparative scope of genetical work in the U.S.S.R. and the esteem in which it is held is illustrated by the fact that in this third year of Russia's participation in the war, she is still the largest foreign subscriber to the chief American scientific journal in this field. More copies go to the U.S.S.R. than to all other foreign countries. Moreover, a standard American text-book which appears in the United States in editions of 2,000 copies is printed in the U.S.S.R. in editions of 15,000.

The spirit in which the Soviet scientists carried on their studies in the difficult days just after the revolution is again in evidence to-day. After the fall of Kiev I received a letter from Professor Gershenson, director of the Genetics Institute of the Ukrainian Academy of Sciences at Kiev, telling of the destruction of the institutes and the loss of the libraries. The personnel had been evacuated to two small towns, one in the Urals and one in Turkestan, and there they were continuing their work. They needed, he wrote, recent American publications and some stocks of Drosophila. We are now collecting books and journals to send to replace those destroyed by the Nazis.

There are to-day literally hundreds of trained genetical investigators in the U.S.S.R., certainly more than in any country outside of the U. S. A. They had already outstripped the Germans in this field even before the advent of Hitler put the quietus on German genetics. Soviet theoretical genetics has developed in close connection with practice, especially with agriculture and medicine, and has been continually

aware of the relationship between its own theoretical structure and the social theory on which the development of the U.S.S.R. has itself been based.

Other aspects of biological research which have shown great expansion and activity include the remarkable outburst of exploring and collecting zeal by which the animals and plants of the vast and varied autonomous republics and of China became known. This began immediately after the Revolution and has resulted in a great enrichment of the museums and in works of first-class importance by both zoologists and botanists. At the same time there began the development of institutes of experimental biology from which has issued important work in experimental morphology, on the analysis of growth, in endocrinology, in physiology and in biochemistry. In the latter field for example the discovery that the contractile protein, myosin, which is the basic component of muscle, acts as an enzyme, was of first-rate significance; while we all have increasing reason now to remember that much of the pioneer work on blood transfusion and plasma storage was done in the Soviet Union. The methods of artificial insemination, now used extensively in Europe and America, were developed almost wholly by Russian workers. It was estimated in 1941 that 50,000,000 farm animals in the Soviet Union alone had been produced by artificial insemination.

In recent years there have appeared in the Russian scientific literature new hybrid names indicating the fusion of independent scientific disciplines to focus on problems which transcend particular fields. Such is biogeochemistry, as conceived by Vernadsky and his group of the Biogeochemical Institute of the Academy of Sciences at Leningrad. Vernadsky took as his field the distribution of chemical elements due to living organisms in the biosphere and has added greatly to our knowledge of the chemistry of alluvial soils and the chemical composition of organisms.

Biological progress in the Soviet Union has not been achieved without cost and sacrifice. At a time when food was scarce they still spared some for their experimental animals and for costly scientific equipment. They took the means to build up science literally out of their necessities, not, as we have done, out of our surplus; and they had only themselves to look to, for the great foundations, which poured their funds for pure research so generously into Germany and western Europe, were never able to make the same arrangements in or for the Soviet Union. Yet in the U.S.S.R. was what in 1927 seemed to me to have been the greatest potential source of new scientific strength in the old world.

Some part of the cost was paid too in the creation of the central control of science which led to what we call red tape and the Russians "spoiling paper," and to an appearance of arbitrariness whenever decisions are made by a central authority. I have no doubt there was wailing and gnashing of teeth on the part of the individual investigators when before the war one of the great biological institutes was suddenly moved from near Leningrad to Moscow, but in view of what the Germans did to Leningrad, I can not believe that the regret of those biologists has survived to the present. These costs, together with other and greater ones, have been and are being paid, and we can now see that not only Soviet citizens but those of all countries stand to reap the benefits.

The progress of biological research in the Soviet Union has taught us a very valuable lesson. It is that control and organization of science by and for the whole community does not kill the scientific spirit or initiative nor submerge the individual scientist in a dead level of anonymity. Great individuals have arisen in Soviet biology, fine discoveries have been made and continue to be made even in the midst of war. Ivan Pavlov, one of the greatest of Russian biologists, began his scientific life under the old régime, but he lived to refute both in word and in deed the dire prophecies of those who said that great scientists and a vital and vigorous science could not survive in a socialist state.

For the sake of biological science itself, we biologists should use all our efforts to see that the barriers which separated Soviet biology and biologists from us should never again be allowed to prevent the free flow of persons and ideas, both scientific and social, on which the progress of science and of society depends.

RUSSIAN EXPLORATIONS[1]

By Sir HUBERT WILKINS

THERE have been many great Russian explorers, and the framework of Soviet Russia's exploration was laid down long before the advent of the Soviet Union. Under the direction of the leaders and organizers of the Soviet Union the platform for exploration, as well as for many other scientific and cultural institutions, was preserved and they have been built up expertly and vigorously by Soviet scientists.

In recent years Soviet explorers have been especially active. I venture to say that in no other country has exploration and the exploitation of the results of ex-

[1] Address at the luncheon of the Congress Celebrating the Tenth Anniversary of American-Soviet Diplomatic Relations, New York, November 6, 1943.

ploration been more energetically and expertly developed and applied than it has been in the Soviet Union.

Modern Russia has been so successfully engaged in so many phases of exploration that it is difficult to say which field has been the most impressive. Political, social, economic, industrial, agricultural, medical, surgical, physical, physiological, geophysical and military phases have each been given intensive attention and the progress the Russians have made in each field is astounding.

There is much that may be said in relation to each and every phase, but because of my association with life in high latitude areas I might be expected to say most about the work that has been done by Soviet explorers in those areas.

They have done much in both the Arctic and sub-Arctic. The Arctic and sub-Arctic areas have long been known to be friendly to those who know and understand them and the Russians, who know them, have found them friendly and profitable. The Russians have done more toward the development and exploitation of their Arctic lands and waters than has either the United States or Canada in their northern territories.

And the developments that have taken place have been of great value to the Russians in relation to the present furious military struggle. From their northern areas the Russians have taken much of the timber and the mineral which have enabled them to so successfully develop the might and power that has already beaten the greatest army and the greatest accumulation of war force the Germans have ever assembled.

From northern lands which were, until a few years ago, known only to the so-called "natives" and the few explorers who ventured into them has come an enormous wealth of supplies.

Rivers which a few years ago were only shown vaguely as irregular lines on a comparatively featureless map, have been harnessed to provide the power which has enabled the production of millions of feet of sawn timber for home use and export. These rivers have also supplied the power to operate mines which have been developed in areas almost entirely unknown, until Soviet geologists recently surveyed them. From these mines have come the wealth of metal which is now being strewn in death-dealing blows at the civilized world's common enemy.

It is not only the foresight and the enterprise of the explorers of the Soviet Union that we must admire, we must admire also the attitude of their political and economic leaders who saw fit to exploit the knowledge the explorers brought home.

The possibility of such exploitation is, of course, dependent upon ways and means to exploit the fields explored and that is why, in the consideration of Soviet exploration, we must not forget the men who as explorers in the field of mechanics have produced the mechanized transport which has made it possible to enter the areas explored and bring from them the fund of wealth they provide.

With airplanes, suitably winterized for operation in such areas the Soviet aviators have carried out the aerial mapping of the Russian Arctic and sub-Arctic areas on such a scale as has seldom been applied to outlying regions in any other country.

I am told that the charting of the coastal or near coastal waters of the Soviet Union's northern borders is almost as detailed as is the charting of our own eastern shores. This is an achievement of no small order for the charting of the Arctic seaboard is not a simple hydrographic matter. There is the element of sea ice to contend with and the influence of distant meteorological activities to consider, for these meteorological influences are distributed irregularly and over a far greater area than are the meteorological influences transmitted through ice-free water.

With the use of and in combination with observation from airplanes the Soviet Merchant Marine has been able to make valuable use of their Arctic seaboard which for years was thought to be utterly impassable. The Soviet merchant fleet and their navy has now made the Northeast passage an established fact.

The opening up of the Northeast passage has opened up tremendous possibilities for traffic in the many northward flowing rivers in the Soviet Arctic and, in turn, great exploitation of the rich sub-Arctic lands.

The Soviet ventures into the inner realms of the Arctic Ocean have not been simple, adventurous endeavors, nor have they been of purely academic interest. They have had a definite, economic complex. The knowledge gained by the Soviet Scientists Polar Drift Expedition for instance has been exceedingly helpful in the prediction of ice movement and subsequent air temperatures and in turn, seasonal conditions. This knowledge has been of great value to military strategists.

The observations made in regard to the ocean currents have been invaluable in relation to the periodical difference in distribution of fish life and of great value to the fishing industry in general.

The soundings of the Arctic Ocean made by the intrepid Soviet airmen who flew out and landed several times on the pack ice far from shore are of extreme interest to geophysicists who are concerned with the structural formation of the world and the knowledge gained by the Soviet scientists has presented a new aspect of the earth's outline.

Soviet researches in relation to magnetism and

magnetic disturbances have been extensive and they are very valuable. The magnetic charts of the Soviet Union are, I am given to understand, much more detailed in relation to the Western Arctic and Siberia than are any U. S. charts of northern areas.

These magnetic observations are of great help to navigators of the air and sea in those areas which are more than often fogbound and so cloud covered as to restrict astronomical navigation.

But the greatest aids to the detailed exploration of the northern areas are the heavy tractor and the "cat trains" which have ploughed their way through swamps and tundra and over highlands and plateaus. We in this country have heard a great deal about the Alaska Highway and the Burma Road. Within the Soviet Union there are several "Alaskan Highways" and many hundreds of miles of "Burma Road" which winds over terrain equally as difficult as anything to be found in China or Burma.

It is, as a matter of fact, over such roads which lead to Kunming and Chungking that the Russians have delivered to the Chinese so much of the ground-warfare supplies that have been used by the Chinese in their successful resistance against the Japanese.

Great web-ways of tractor roads over Russia have opened great and rich food-producing areas in Central and in Northern districts and have played no small part in the glorious successes of the Soviet Army.

In the far north tractors have provided the means for transport throughout a great part of the year, but they operate most successfully during the depth of winter when the ground and the swamps and the rivers are solidly frozen over.

Such transportation has opened up vast fields for occupation and this in turn has led to much exploration in the Soviet Union in respect to soil chemistry and the development of a quick-growing variety of grain-producing plants. Wheat, oats and barley suitable for growing in the short Arctic summer season have been developed on the agricultural farms for research in the Soviet Union. And in respect to these findings, the Soviet scientists have given liberally to others in many parts of the world. The rich harvests produced in northern Canada are, in a great measure, due to the research and results of Soviet scientific exploration.

The development of such grain-producing, short-season varieties of plants is a matter of great importance to the United States if, for instance, the development of Alaska is undertaken. There are millions of acres in Alaska which are as suitable for development as the millions of acres in similar latitude and climatic conditions in the Soviet Union. The difference is, mainly, that there is no population in Alaska to take advantage of these areas.

There are others at this meeting who will tell you of the civic and cultural explorations within the Soviet Union, but I believe that only those of us who were privileged to see the beginning of that splendid and healthy development and who were in a position to realize the magnitude of the task can appreciate fully the tremendous progress that has been made in the Soviet Union between the years of 1923 and 1943.

How far such developments will effect the friendly cooperation of the two great countries, the U. S. A. and the U.S.S.R., is a matter for mutual consideration. It is my belief that such friendliness and cooperation can and should be boundless.

The magnitude of the cooperation might depend largely on the development the United States is prepared to make in her northern areas. But whatever the efforts of the United States may be, it can be taken for granted that through the field of exploration, followed by healthy, energetic exploitation, the U.S.S.R. will shortly, as world time is measured, be able to stand side by side with the United States in no disproportionate stature. And it will not be long, as world time is measured, before the U.S.S.R., with her multitudinous population and tremendous resources, will stand towering above the United States in material and economic magnitude. This is a matter for pleasant contemplation, provided we encourage and maintain the cooperation that is greatly to be desired.

SOME MODERN CONCEPTIONS OF AMEBIASIS
II

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PATHOLOGY AND SYMPTOMOLOGY

It is not the purpose of this paper to provide a clinical description of amebiasis but rather to analyze some of the fundamental evidence on host-parasite inter-relationship in amebiasis which may assist the clinician in visualizing his problems. A clear picture of the levels at which the amebic lesions occur, their numbers and the depths of penetration of the amebae constitutes the essential fundamental background for a clinical appreciation of the disease. Thus, a mucous

diarrhea, with amebic trophozoites in the stool, but without macroscopic blood suggests early, rather extensive superficial invasion of the bowel wall or a mild relapse, while a fulminating dysentery indicates deep invasion in at least one focus, usual in the rectal area.

Perhaps the most commonly overlooked syndrome which should suggest the possibility of amebiasis, especially in tropical countries, is that of appendicitis. Amebic lesions in the cecum, appendix or adjacent levels of the ileum or ascending colon may give rise to dull throbbing or intense knife-like pain in the lower right quadrant of the abdomen or by reference the pain may suggest gall bladder disease or peptic ulcer. Patients having infection at this focus may consistently pass stools which are formed or constipation may alternate with diarrhea. In New Orleans 10 per cent. of appendicitis cases in the surgical service of Dr. Alton Ochsner in Charity Hospital were found to have amebic involvement.[69] In the Santo Tomas Hospital in Panama the frequency has been one third of appendicitis cases coming to operation. Early recognition by the clinician of the frequency of amebiasis of the cecal area usually allows management of the case by the internist and prevents unnecessary surgical intervention, since anti-amebic therapy in these cases will probably eventually be required.

Asyndromic amebiasis[70] may cause general colonic disturbance, nervous symptoms or fatigue. In such patients one or more well-established amebic ulcers have usually developed, most commonly in the cecal area.

In chronic amebiasis the amebic lesion is usually secondarily infected with bacteria, which provokes an infiltration of neutrophilic leukocytes. Moreover, in this type of amebiasis a moderate leukocytosis is frequently observed in the circulating blood, so that the blood picture disguises the diagnosis of amebiasis.

Amebic invasion of the liver is probably much more common than the records of acute hepatic amebiasis indicate. Amebae which enter the mesenteric venules in the submucous coat of the large bowel are swiftly carried to the liver, to be filtered out in the portal capillaries. In the great majority of cases the amebae do not colonize in the liver parenchyma but soon die. The cause of this amebostatic action is unknown, but it is plausible that the same unknown substance in liver extract which has been found experimentally to control the infection in the bowel operates even to a greater degree in the liver itself. If the suggestion may be carried one step farther, it is possible that a quantitative reduction in the production of this as yet unknown fraction of liver extract allows the amebae to multiply, with resultant amebic hepatitis or liver abscess.

[69] A. Ochsner, *Surgery*, 1: 633–636, 1937.

[70] J. S. D'Antoni, *New International Clinics*, Ser. 5, 1: 101–109, 1943.

Diagnosis

While an internist who has had years of experience in the study of dysenteries can frequently make an accurate diagnosis of fulminating amebic or bacillary dysentery on the macroscopic appearance of the freshly passed stool, this method does not provide a safe basis for diagnosing amebiasis in its broader aspects. In practice it is necessary to recover *Endamoeba histolytica* itself either in its trophozoite or cystic stage, and to differentiate it from other protozoa of the digestive tract as well as from macrophages and *Blastocystis*.

Visualization of the organism can be accomplished from microscopic films prepared from formed, semiformed or liquid stools, from purgative or enema specimens, from proctoscopic material or after *in vitro* culture of the ameba. None of these is 100 per cent. efficient.

In the laboratories of the Department of Tropical Medicine of Tulane University the following routine method of examination for *Endamoeba histolytica* has been in operation for several years. First of all, microscopic films of the freshly passed stool are prepared. These consist of (1) a direct film, one side unstained, one side stained with D'Antoni's iodine; (2) a supplementary hematoxylin-stained direct film; (3) a film resulting from concentration of cysts by the zinc sulfate centrifugal flotation technique. Three stools, passed on alternate days or preferably every third day, are examined in this way. Both by practical tests and by calculation it has been found that 85 to 90 per cent. of positive cases are diagnosed by these combined techniques on the three stool samples, whereas a single direct fecal film accounts for only 20 to 25 per cent. of *E. histolytica* positives. In individual cases with a history of chronic colitis proctoscopic examination, purgation with Glauber salts or phospho-soda, or high physiologic salt enemas are carried out.

While cultures of the specimen on *E. histolytica* culture media are satisfactory for the demonstration of the organism recovered from liquid or semi-liquid stools, cysts of this organism at times fail to excyst in the culture medium, thus providing false evidence of a negative.

In areas or population groups of high endemicity, in which there is not only a high incidence of infection in the population but also a large number of amebae per individual, evidence of infection is readily obtained from stool examination. In areas of low endemicity, in which the incidence is low and the average number of amebae per individual is small,

the problem of diagnosis is difficult or at least tedious. In the United States very high incidence occurs in certain population groups, as in rural areas of the Southern Appalachians and in children's asylums in New Orleans. In other areas, particularly in the north, the incidence may be as low as 1 per cent., although in most regions it varies between 5 and 10 per cent. The ease or difficulty experienced in the diagnosis of *Endamoeba histolytica* in any particular locality will depend not only on the skill of the diagnostician and the methods which he utilizes but also on the wealth or dearth of the amebae in the patient's feces.

TREATMENT

It would be unsuitable for the writer to deliver a set of dicta on anti-amebic treatment for the practising physician, but there are certain basic observations which are relevant and proper.

Twenty-five years ago ipecac was commonly utilized in the treatment of acute or chronic amebic colitis. It frequently cured the patient who could retain enough of the drug to act on the amebae. Meanwhile emetine hydrochloride had been demonstrated to be very effective in bringing the infection under control and particularly in alleviating symptoms. Stovarsol (acetarsone), originally prepared by Ehrlich, was first utilized by the French for the treatment of syphilis and African sleeping sickness, but by 1920 it was found to be effective in the control of amebiasis. Because of the high percentage of patients taking the drug who developed severe intestinal colic as well as other types of arsenic intolerance, this product has been practically replaced in recent years by less toxic anti-amebic drugs. Carbarsone, another arsonic acid compound originally prepared by Ehrlich, was introduced by Anderson and Reed in 1931[71] as a highly specific drug for the treatment of amebiasis and was described as much better tolerated than stovarsol. Meanwhile, in 1921, Mühlens and Menk[72] advocated the use of chiniofon, an iodo compound which they introduced under the trade name "Yatren." This drug was soon given extensive clinical trial and found to be a very efficient and well-tolerated anti-amebic drug. In 1936 diodoquin, another iodo compound, was released by Searle for clinical trial in the treatment of amebiasis. Its use is gradually being extended as its anti-amebic value and high tolerance are being demonstrated. Vioform, a third iodo compound, has been recommended for the treatment of amebiasis but has never been widely used.

To-day the drugs most commonly prescribed for amebiasis in the United States are emetine hydrochloride, carbarsone, chiniofon and diodoquin. Emetine hydrochloride is the only known eminently satisfactory preparation for the treatment of amebic hepatitis and amebic liver abscess. For amebiasis of the intestinal tract its usefulness consists primarily in controlling acute symptoms, but within limits of safe administration it can not be guaranteed to terminate the infection. For routine treatment of amebic colitis, whether acute, chronic or "carrier type," carbarsone, chiniofon and diodoquin constitute the present-day drugs of choice. For patients with arsenic intolerance one of the iodo preparations should be utilized. Moreover, in experimental amebiasis in the dog the writer and a junior colleague[73] have recently demonstrated that carbarsone has only a 75 per cent. amebicidal efficiency compared with chiniofon. For a short course of treatment chiniofon is most likely to eliminate the infection, but in some persons it provokes a severe watery diarrhea. Diodoquin apparently has no contraindications, but requires a longer period of treatment because of its slower absorption rate into the bowel wall.

An analysis of the present status of chemotherapy in amebiasis indicates that marked progress has been made in the past quarter of a century in the development of a few relatively specific drugs which are rather well tolerated by the patient. Yet in amebic colitis no one of these drugs and occasionally no combination of them provides a guaranteed cure. There is abundant need and opportunity to explore other preparations, including refined products of crude drugs utilized by Oriental and Amerind peoples, as well as new synthetics.

Finally, a suggestion may appropriately be made concerning the nutritional state of the patient in amebiasis. Experimental evidence suggests that during the period of treatment the carbohydrate intake should be reduced and that nutritious, readily digestible animal proteins should be increased. The possible role of vitamins in raising the threshold of resistance to the pathogen has never been given experimental or clinical trial, either in preventing infection or in controlling tissue invasion. This suggests the need for serious intensive study.

CONTROL

Justification of preventive measures in any particular disease is based on two premises: (1) that the disease is clinically important and (2) that it is a public health hazard. In an infection like amebiasis it is easier to dodge the issue than to meet it squarely and to provide machinery for practical control. Yet an honest evaluation of the evidence in amebiasis

[71] H. H. Anderson and A. C. Reed, *Calif. and Western Med.*, 35: 439–443, 1931.

[72] P. Mühlens and W. Menk, *Münch. med. Wochenschr.*, 68: 802, 1921.

[73] E. C. Faust and J. E. Tobie. Unpublished experiments.

definitely indicates its actual or potential danger to individuals and communities which harbor the etiologic agent.

The problem of control is somewhat simplified by remembering that reservoir hosts play no important part in the propagation of amebiasis, so that man may thank himself for the infection. Moreover, the individual who is least likely to manifest symptoms, namely, the so-called "carrier case" who is passing cysts in his stools, is the primary offender. Exposure occurs through entry of viable infection-stage cysts of *Endamoeba histolytica* as a contamination into the mouth. Infection may occur from a single massive dose of cysts, or from repeated lighter doses taken into the mouth in food or water. While the epidemiologic evidence is not conclusive, it is apparent that the safeguarding of food and drink from contamination should do much to protect the population. The public must be made aware that dirty food handlers should not be tolerated. By sanitary regulations these individuals should be examined for amebic infection and, if found positive, should be treated until they are negative. Filth flies should not be allowed to breed; they are not only a menace in this infection but in practically all other diseases primarily involving the gastro-intestinal tract. Thorough sanitary campaigns should be carried out in eleemosynary institutions to clean out these hotbeds of infection. An awakening of the public consciousness regarding the potential dangers of amebiasis constitutes an additional essential part of the control program. Meanwhile the practicing physician, by his respectful attitude towards amebiasis in his own patients, whether they manifest symptoms or are apparently symptomless, can do much to further this end.

CONCLUSIONS

The material which has been presented in this paper is not intended for immediate practical application by the clinician but as a basis for reorientation and re-evaluation of the problem of amebiasis. Some of the remarks are personal reflections of the writer which have never previously been expressed except in informal conferences. It is believed, however, that the subject justifies this type of presentation. It is the writer's sincere hope that some little stimulus will have been provided which will aid the physician and the epidemiologist in elucidating the several obscure aspects of the problem of amebiasis, so that in the future practical means may be found for its control.

It has been a very real honor to be the 1943 recipient of the Alvarenga Prize of the Philadelphia College of Physicians and a privilege to address this distinguished body.

OBITUARY

L. CHARLES RAIFORD

PROFESSOR L. CHARLES RAIFORD died on January 8 at the age of seventy-one years after a very short illness. He is survived by a daughter, Mrs. Mark Hagerman, of Towanda, Pa., and a grandson, Mark, Jr.

Professor Raiford was born on August 2, 1872, in Southampton County, Va. He received the Ph.B. degree at Brown University in 1900, the M.A. in 1904 and the Ph.D. at the University of Chicago in 1909. He was on the teaching staff at the Mississippi Agricultural College, the University of Chicago, Clemson College, the University of Wyoming and the Oklahoma A. and M. College before going to the University of Iowa in 1918, where he served as professor of organic chemistry up to the time of his death. He was also head of the division of organic chemistry until 1942 when he reached the age of seventy years. During this period he directed the research of over a hundred graduate students for advanced degrees. These are scattered all over the United States in teaching and industrial positions.

Professor Raiford was a fellow of the American Association for the Advancement of Science, a member of the American Institute of Chemists, the American Chemical Society, the American Association of University Professors, the Oklahoma Academy of Science, the Iowa Academy of Science, Sigma Xi, Phi Beta Kappa, Phi Lambda Upsilon, Alpha Chi Sigma, Phi Delta Chi, the Research and Triangle Clubs. In the American Chemical Society, he served as national chairman of the organic division in 1937. In the local section of that organization, he served as chairman and secretary and was elected councilor nine times, a very notable record which indicated his popularity and standing in the profession.

Professor Raiford was active in these societies and always willing to do any service, no matter how much work was involved. He was president of Phi Beta Kappa in 1922–23 and was local secretary of that organization when a national directory was prepared, to which undertaking he contributed by gathering the necessary data for the members of the Iowa chapter. He represented the department of chemistry on the library board for many years, and the excellent maintenance of the chemistry library was due in great measure to his efforts. He served as president of the Research Club.

In 1942, when he reached his seventieth birthday, a testimonial dinner was given in his honor at the Alpha Chi Sigma chemical fraternity at which addresses were

given by faculty colleagues and letters read from former students. At that time a watch was presented to him from former students and members of the local chapter of Alpha Chi Sigma.

Professor Raiford was the author of a "Laboratory Course in Color Chemistry," since 1936 a member of the board of editors of the *Journal of Organic Chemistry,* and contributed many articles to scientific journals.

Funeral services were held on January 11. Dr. M. Willard Lampe officiated, and honorary pallbearers were Edward Bartow, Perry A. Bond, George H. Coleman, Jacob Cornog, Homer R. Dill, George Glockler, Hubert L. Olin, Henry A. Mattill and J. Hubert Scott.

GEO. GLOCKLER

THE STATE UNIVERSITY OF IOWA

LEVIN BOWLAND BROUGHTON

L. B. BROUGHTON, dean of the College of Arts and Sciences of the University of Maryland, died suddenly at his home in College Park, Md., on December 13, 1943. A correspondent writes:

"Dean Broughton was born in Pocomoke City, Md., on March 29, 1886. In 1908 he was graduated from the Maryland Agricultural College, by which college he was awarded the M.S. degree in 1911. He received his Ph.D. in chemistry from the Ohio State University in 1926. Dean Broughton's association with the University of Maryland continued from 1904 until his death. After graduation he was assistant chemist at the Experiment Station until 1916. He then became, in succession, associate professor in 1916, professor in 1918 and department head in 1929, on which date he also became state chemist of Maryland. In 1938 he was appointed dean of the College of Arts and Sciences, which office he filled with marked success until the day of his death. Within the year Governor O'Conner appointed him a commissioner of the Maryland State Department of Geology, Water Resources and Mines. He was best known for his researches in agricultural chemistry. Among these were studies in soil acidity, the ascaridole content of chenopodium oil, potash as a by-product of alcohol production, biological changes in pork during curing and vitamin assays. During 1941 he was honored with the presidency of the Association of Official Agricultural Chemists. He was also a member and sometime councilor of the American Chemical Society, Sigma Xi, Alpha Chi Sigma, Kappa Alpha, Phi Kappa Phi, Omicron Delta Kappa and the Rotary Club."

RECENT DEATHS

DR. J. MCKEEN CATTELL, editor of SCIENCE for nearly fifty years, formerly professor of psychology at Columbia University, died on January 20 in his eighty-fourth year.

DR. COLIN C. STEWART, Brown professor of physiology at Dartmouth College, died on January 22 at the age of seventy years. He had been a member of the Dartmouth faculty for the past forty years.

DR. FREDERICK SCHEETZ JONES, formerly professor of physics and electricity at the University of Minnesota, where he became dean of the School of Engineering in 1902, died on January 14 at the age of eighty-one years. He was dean of Yale College from 1909 to 1927.

DR. ALBERT E. TAUSSIG, professor of clinical medicine at the Washington University Medical School, a former director of medical service of the Jewish Hospital of St. Louis, Mo., died on January 16 at the age of seventy-two years.

ROBERT S. LEHMAN, a member of the firm of Alfred and Robert S. Lehman, retail druggists of New York City, a former president of the New York State Pharmaceutical Association, the Academy of Pharmacy and the Pharmaceutical Council, died on January 15 at the age of seventy-six years.

SCIENTIFIC EVENTS

GIFT TO THE UNIVERSITY OF OXFORD FOR PLASTIC SURGERY

IT is reported in *The Times,* London, that the Nuffield Provincial Hospitals Trust, at Lord Nuffield's suggestion, has offered the University of Oxford £8,000 a year for ten years towards the cost of establishing and maintaining a plastic surgery unit there. The university has accepted the offer with gratitude and has appointed Thomas Pomfret Kilner as the first director of the plastic surgery unit with the title of Nuffield professor of plastic surgery. The Radcliffe Infirmary will provide hospital facilities for the unit, and these will be supplemented by the Ministry of Pensions.

Lord Nuffield's direct personal gifts to the University of Oxford for the purpose of the development of the Medical School amount to £2,810,000. His series of great and related benefactions began in 1930 with the purchase of the Observatory Buildings and grounds adjoining the Radcliffe Infirmary, which he gave to the university to be used for the purpose of medical teaching and research, this being followed by a second gift of £2,000,000 for the development of the Medical School.

The new unit will be a center for the training of plastic surgeons, and will work in close touch with the university laboratories in which parallel investigations of the biochemical and other problems connected with the growth and repair of tissue, fundamental to plastic surgery, will be carried on. It is felt that there is an urgent need to have such a center in Great Britain.

The war has brought a greatly increased demand for the services of plastic surgeons and Lord Nuffield's proposal was chiefly influenced by a desire to provide the best possible treatment for casualties, especially those suffering from disfigurement caused by burns. Even though the demand may be less after the war, plastic surgery will have, unquestionably, a most important part to play in the services which are being envisaged by the government for the rehabilitation of injured persons.

AFFILIATION OF PSYCHOLOGICAL ORGANIZATIONS

It is reported by Science Service that a movement is now on foot to combine the nine leading national psychological associations and groups of psychologists into a single national association. Details of the merger are being worked out by a committee appointed by representatives of all the present organizations.

Final action ratifying the new constitution is expected on the part of the two largest organizations, the American Psychological Association and the American Association for Applied Psychology, in September. Difficulties may arise due to the fact that the annual business meetings of these organizations were cancelled last year due to war-caused transportation difficulties. It is not now known whether a meeting will be held for this purpose, whether action will be taken by the administrative councils of the organization or whether members will be asked to vote by mail.

The new organization, which will also be called the American Psychological Association, will have, it is planned, a number of divisions, each with its own chairman, secretary and other officers. The divisions will sponsor programs, the annual meetings and may also publish journals. Any member may belong to one or more divisions.

Government of the new association will be by a council of representatives to be elected by the various divisions and regions and by certain unorganized groups. The council will meet annually and elect a board of directors and several other boards and committees to do the work of the association.

It is anticipated that 4,000 psychologists will be members of the new association. Organizations that appointed representatives to plan the merger include the American Psychological Association, the American Association for Applied Psychology, the Society of Experimental Psychologists, the Society for the Psychological Study of Social Issues, the Psychometric Society, the National Institute of Psychology, the National Council of Women Psychologists, the Department of Psychology of the American Teachers Association and Section I of the American Association for the Advancement of Science.

THE CLEVELAND MEETING OF THE AMERICAN CHEMICAL SOCIETY

The one hundred and seventh meeting of the American Chemical Society, under the presidency of Dr. Thomas Midgley, Jr., will be held in Cleveland from April 3 to 7. Several thousand chemists and industrialists will participate.

Fourteen of the eighteen professional divisions of the society will convene. Postwar planning will be emphasized at the sessions of the division of industrial and engineering chemistry under the chairmanship of Dr. Lawrence W. Bass, of Boston. Progress in petroleum chemistry will be described before the petroleum division, of which Dr. Cecil L. Brown, of the Standard Oil Company of Louisiana, Baton Rouge, is chairman.

"Antiparasitic Agents as Used in Tropical Diseases Other than Malaria" will be the general theme of the division of medicinal chemistry, of which Dr. John H. Speer, of G. D. Searle and Company, Niles Center, Ill., is chairman. "The Biological Value of Proteins" and "Carbohydrates for Industrial Use" will be discussed at a joint meeting of the division of agricultural and food chemistry and the division of sugar chemistry. Papers on vitamins will be read at a session of the agricultural and food and biological divisions.

"Industrial Demands for Non-Laboratory Chemists" will be the topic of the division of chemical education, of which Dr. Laurence L. Quill, of the Ohio State University, is chairman. Papers on "Detergents and Their Actions on Biological Systems" and "Theory of Long-Range Elasticity" will be submitted to the division of physical and inorganic chemistry, of which the chairman is Dr. Oscar K. Rice, of the University of North Carolina.

General sessions will be held by the divisions of analytical and micro-chemistry, cellulose chemistry, colloid chemistry, gas and fuel chemistry, organic chemistry, sugar chemistry and technology, and water sewage and sanitation chemistry.

Registration will begin on Sunday, April 2, at the Hotel Cleveland and the Hotel Statler, joint headquarters for the sessions. Divisional meetings will take place in the Cleveland Public Auditorium beginning on Monday, April 3, at 2 P.M. and ending on Friday at 5 P.M. The council, of which Dr. Midgley is chairman, will meet on Monday at 9:30 A.M. A general meeting is planned for Wednesday at 2:00 P.M. The semi-annual dinner meeting will take place on Wednesday at 7:00 P.M.

Dr. Carl F. Prutton, professor of chemical engineering at Western Reserve University, has been appointed general chairman of the meeting. Dr. Eric A. Arnold, associate professor of chemistry at the Case School of Applied Science, has been named general vice-chairman. Dr. Harold S. Booth, head of the department of physical science at Western Reserve, is honorary chairman.

Vice-chairmen to direct the work of local committees on arrangements for the convention are W. J. Bartlett, Mathew M. Braidech, G. H. McIntyre, A. S. Weygandt and F. M. Whitacre.

AWARDS OF THE INSTITUTE OF THE AERONAUTICAL SCIENCES

THE Institute of the Aeronautical Sciences under the presidency of Major R. H. Fleet opened its twelfth annual meeting with the "honors night" dinner in the Waldorf-Astoria, New York City, on January 24. The following awards were made:

General Henry H. Arnold, commanding general of the Army Air Forces, an honorary fellowship, presented by Brigadier-General Frank P. Lahm, retired.

Sir Richard Fairey, director-general of the British Air Commission, an honorary fellowship, presented by T. P. Wright, of the War Production Board.

Sanford A. Moss, consulting engineer of General Electric, the Sylvanus Albert Reed award, presented by Charles L. Lawrence, head of Lawrence Engineering and Research.

Lieutenant-Colonel Joseph J. George, of the Army Air Forces Weather Division, the Robert M. Losey award, presented by F. W. Reichelderfer, chief of the United States Weather Bureau.

Brigadier-General Eugen G. Reinartz, commandant of the Army School of Aviation Medicine, the John Jeffries award, presented by Major-General D. N. W. Grant, air surgeon of the Army Air Forces.

William H. McAvoy, chief test pilot of the National Advisory Committee for Aeronautics, the Octave Chanute award "for continuous service in the flight-testing of experimental airplanes under hazardous conditions."

William B. Bergen, chief flight test engineer of the Glenn L. Martin Company, the Lawrence Sperry award, presented by E. G. Sperry, Jr., vice-president of Sperry Products.

Colonel H. F. Gregory, of the Army Air Forces, the Thurman H. Bane award "for his contribution to the military and commercial development and use of the helicopter," presented by Igor I. Sikorsky, of the Vought-Sikorsky Aircraft Division of United Aircraft.

THE GIBSON ISLAND RESEARCH CONFERENCES

THE seventh series of the Gibson Island special research conferences on chemistry of the American Association for the Advancement of Science will begin on June 12. There will be eleven conferences during the summer of 1944, each extending over a period of five days, from Monday to Friday, inclusive, on successive weeks. The final conference will open on Monday, August 21. The subjects of the eleven conferences are:

1. Petroleum Chemistry. June 12–16. Frederick D. Rossini, *chairman;* George Calingaert, *vice-chairman.*
2. Catalysis. June 19–23. Otto Beeck, *chairman;* P. H. Emmett, *vice-chairman.*
3. Organic Highpolymers. June 26–30. H. Mark, *chairman;* Emil Ott, *vice-chairman.*
4. Medicinal Chemistry. July 3–7. D. L. Tabern, *chairman;* W. G. Bywater, *vice-chairman.*
5. Textiles. July 10–14. Milton Harris, *chairman;* Warren F. Busse, *vice-chairman.*
6. Strategic Materials. July 17–21. Robert Calvert, *chairman;* Richard J. Block, *vice-chairman.*
7. Vitamins. July 24–28. Walter C. Russell, *chairman;* James Waddell, *vice-chairman.*
8. Cancer. July 31–August 4. Dean Burk, *chairman;* Ralph G. Meader, *vice-chairman.*
9. Corrosion. August 7–11. F. L. LaQue, *chairman;* G. H. Young, *vice-chairman.*
10. Instrumentation. August 14–18. W. G. Brombacker, *chairman;* J. G Ziegler, *vice-chairman.*
11. X-ray and Electron Diffraction. August 21–25. Lester H. Germer, *chairman;* P. Debye, *vice-chairman.*

The island offers opportunities for golf, tennis, bathing in both salt and fresh water, fishing and swimming. Yacht races are held off the shore at various times during the summer.

The conference property was purchased and furnished by the association with gifts of $1,000 each from industrial companies whose laboratories have been represented at the conferences, each company having the right to have one representative at each conference. Attendance is limited to 60 persons, distributed as widely as possible among representatives of industrial, foundation and university laboratories.

Registration for the coming summer should be made before February 20 with the director, Dr. Neil E. Gordon, Wayne University, Detroit, who is secretary of the Section on Chemistry of the association.

SCIENTIFIC NOTES AND NEWS

THE Distinguished Service to Geography Award of the National Council of Geography Teachers has been given to President Wallace W. Atwood, of Clark University, "for his persistent efforts to advance geography, especially for his headship, since 1920, of the Graduate School of Geography at Clark University and his establishment and editorship of *Economic Geography* since 1925."

THE Edison Medal of the American Institute of Electrical Engineers was presented to Dr. Vannevar Bush at a general session of the institute on January 26. As already recorded in SCIENCE, the medal was awarded in recognition of "his contribution to the advancement of electrical engineering, particularly through the development of new applications of mathematics to engineering problems, and for his eminent service to the Nation in guiding the war research program."

THE International Acetylene Association presented at a dinner given on January 24 at the Union League Club, New York City, the James Turner Morehead Medal to Charles Ellison MacQuigg, dean of engineering at the Ohio State University, "for advancing the oxy-acetylene processes through metallurgical research and for leadership in engineering education."

THE Founders Gold Medal of the Horticultural Society of New York for "outstanding achievement in horticulture" was presented on January 19 to A. T. De La Mare, editor of *The Florists Exchange and Horticultural Trade World,* a weekly magazine that he has published for fifty-five years.

DR. FLORENCE B. SEIBERT, of the Henry Phipps Institute, associate professor of biochemistry in the University of Pennsylvania, has been elected, in recognition of her work in tuberculosis, a national honorary member of Sigma Delta Epsilon, the Graduate Women's Scientific Fraternity.

IT is reported in the *Journal* of the American Medical Association that Dr. Robert Denison, president of the Harrisburg, Pa., Academy of Medicine, has received the Seibert Memorial Prize of $500. The award was established in memory of the late Dr. William Seibert by his sister and was originally intended for study abroad. It is given every two years to a member of the academy who has done notable work.

DR. THOMAS J. HEADLEE, known for his work on mosquito control in New Jersey, retired on January 1 with the title emeritus after serving since 1912 as chief of the department of entomology of Rutgers University and of the State Agricultural Experiment Station. Dr. Bailey B. Pepper, associate entomologist, has been named acting head of the department. A tea was given in honor of Dr. Headlee on the occasion of the annual conference of the New Jersey Extension Service. It was attended by many county extension workers as well as by members of the faculty of Rutgers University who had worked with him from time to time. Dr. William H. Martin presented Dr. Headlee with a chair and a lamp on behalf of the staff of the institution.

MALCOLM PIRNIE, sanitation engineer of New York City, has been elected president of the American Society of Civil Engineers, and Richard E. Dougherty, vice-president of the New York Central Railroad, has been elected vice-president. They took office at the annual meeting on January 17.

CHANCELLOR SAMUEL P. CAPEN, of the University of Buffalo, was elected at the annual meeting held in New York City on January 19 president of the Association of Colleges and Universities of the State of New York.

THE following have been elected officers of the American Society for X-ray and Electron Diffraction: W. H. Zachariasen, department of physics, University of Chicago, *Vice-president* for 1944 and *President-elect* for 1945, and J. D. H. Donnay, Laval University, Quebec, and Hercules Powder Company, Wilmington, Del., *Secretary-Treasurer* for 1944. Dr. L. H. Germer, of the Bell Telephone Laboratories at Murray Hill, N. J., is president for 1944. The next meeting of the society will be a joint Research Conference with Section C of the American Association for the Advancement of Science next August at Gibson Island, Md.

AT the January meeting of the New York City Branch of the Society of American Bacteriologists, the following officers for 1944 were elected: *President,* Mrs. Mary B. Horton, Sheffield Farms Company, Inc., New York; *Vice-president,* Dr. Gustav I. Steffen, New York City Department of Health; *Secretary-Treasurer,* Dr. Mortimer P. Starr, Brooklyn College; *Corresponding Secretary,* Dr. C. Virginia Fisher, Warner Institute; *Program Committee,* Dr. William W. Browne, the City College.

DR. GEORGE MORRIS PIERSOL, professor of medicine in the Graduate School of Medicine of the University of Pennsylvania, past president of the American College of Physicians and a member of the Council on Physical Therapy of the American Medical Association, has been appointed director of the new Center for Research and Instruction in Physical Medicine in the Graduate School of Medicine of the university. To establish this center the National Foundation for Infantile Paralysis recently made a grant amounting to $150,000 for a five-year period from January 1, this year, to December 31, 1948.

DR. ROBERT C. MAJOR has resigned as assistant in surgery at the School of Medicine of Emory University, Atlanta, to become full-time professor of thoracic surgery at the School of Medicine of the University of Georgia at Augusta, effective on January 1. Dr. John Robert Rinker, Fort Worth, has been appointed full-time professor of urology at Georgia.

G. W. GROFF, who has been, since its founding in 1921, dean and director of the College of Agriculture

of Lingnan University, China, has been appointed lecturer on world agriculture at the Pennsylvania State College.

WHILE on leave of absence from the Graduate School of Medicine of the University of Pennsylvania, where he is a member of the faculty, Dr. Kehar Singh Chouke is serving, during the first six months of the current year, as visiting associate professor of anatomy at the School of Medicine of Washington University, St. Louis.

DR. ROBERT WILSON, since 1908 dean of the College of Medicine of the State of South Carolina, Charleston, associated with the college since 1893, has presented his resignation. He will be succeeded by Dr. Kenneth M. Lynch, who has been assistant dean since 1935.

DR. GEORGE R. COWGILL, of the School of Medicine of Yale University, has been promoted from an associate professorship of physiological chemistry to a newly established professorship of nutrition.

DR. GEORGE B. PEGRAM, professor of physics and dean of the Graduate School of Columbia University, and Dr. William J. Robbins, director of the New York Botanical Garden, have been elected members of the Council of the American Association for the Advancement of Science. Dr. Arthur H. Compton, professor of physics at the University of Chicago, and Dr. Elvin C. Stakman, professor of plant pathology at the University of Minnesota, have been elected members of the Executive Committee.

STANLEY FIELD has been reelected for the thirty-sixth consecutive year president of the Chicago Natural History Museum, formerly the Field Museum of Natural History.

DR. ISAIAH BOWMAN, president of the Johns Hopkins University, has been appointed by Secretary Hull a member of the policy committee of the Department of State recently organized "to facilitate the conduct of foreign relations of the United States in war and in peace."

THE United Fruit Company has announced the organization of a Department of New Crops. Dr. Atherton Lee, formerly director of the Puerto Rico Experiment Station of the U. S. Department of Agriculture and subsequently chief of the Natural Rubber Section, Office of the Rubber Director, will be director of the new department. First attention will be devoted to the production of tropical strategic crops for the war effort and subsequently of tropical food crops to aid after-invasion economy.

DR. RUFUS S. REEVES has been appointed for a four-year term director of health of Philadelphia to succeed Dr. Hubley R. Owen. He took office on January 3.

MAJOR GUSTAVE J. DAMMIN, of the Medical Corps of the Army, after serving for two and a half years at the Antilles Medical Department Laboratory, during the last year of which he was commanding officer, is returning to the continental United States to join another laboratory unit.

DR. L. J. WITTS, Nuffield professor of clinical medicine in the University of Oxford, and Dr. J. R. Learmonth, professor of surgery at the University of Edinburgh, have been appointed members of the British Medical Research Council.

DR. WILLIAM E. LADD, William E. Ladd professor of child surgery at the Harvard Medical School, gave the twelfth annual series of the Benjamin Knox Rachford Lectures on January 18 and 19. The lectureships were established as a memorial to Dr. B. K. Rachford in recognition of his work in the physiology of digestion and other scientific investigations.

DR. CHARLES F. CHURCH, chief of the medical department of E. R. Squibb and Sons, delivered recently lectures on "Penicillin—Its Background and Therapeutic Uses," before the Baltimore City Medical Society, the Georgia Pediatric Society, the University of Georgia Medical School, the District of Columbia Medical Society and the Philadelphia College of Pharmacy and Science.

THE annual meeting of the American Association of Cereal Chemists will be held on May 23, 24 and 25 at the Nicollet Hotel, Minneapolis. It is urged that all those who anticipate attending this meeting make their railroad and hotel reservations at the earliest possible moment so that a minimum of confusion and disappointment may result to those attending this convention.

A MEETING of leaders of nutrition research was held at the University of California at Berkeley on January 25 and 26. This is one of four regional meetings which will include all the states. The purpose of the conferences is to evaluate experiments in progress on the conservation of the nutritive value of foods.

A SYMPOSIUM on the industrial application of x-ray diffraction will be held at the Polytechnic Institute of Brooklyn, on Friday evening, February 25, and Saturday morning and afternoon, February 26.

BY the will of Dr. William Llewellyn Pryce Bevan the University of Edinburgh will receive a bequest of approximately £22,000 for the promotion of the teaching or the advancement of medical science.

THE Council of the National Institute of Sciences of India, according to *Current Science*, Bangalore,

has been authorized to take necessary steps for the organization of a National Research Council constituted under the statutory authority of the Government of India, at the symposium on Post-War Organization of Scientific Research held last October in Calcutta. It was also decided to approach the Government of India for an annual grant to enable the council to give effect to its policy of scientific development. The symposium considered that the National Research Council should be directly responsible to the government. Its main functions should be to plan the main lines of scientific work in accordance with national needs, to ensure balanced development of all branches of science and advise and help regarding the training and supply of scientific personnel for pure and applied research. The council should consist of scientific and technical experts not exceeding sixty in number, the majority of whom should be elected by non-official scientific organizations, including universities. Boards of research should be constituted for each sphere of work, and each board should be authorized to constitute research committees on all important subjects.

THE Pyrethrum Board of Kenya has been asked by the British Ministry of Supply to send 10,000 pounds of pyrethrum seed to the United States Board of Economic Warfare. The seed will be flown across the Atlantic and probably planted in Brazil.

A NATIONAL Department of Public Health and Social Assistance was recently established at Buenos Aires, of which Dr. Eugenio A. Galli, major surgeon, R. A., has been appointed president. It includes the National Department of Hygiene, the Advisory Committee of Regional Hospitals, the National Institute of Nutrition, the Society of Beneficence of the Federal Capital, the National Centers of Social Assistance, the Department of Subsidies and all the national branches of the departments of Public Health and Hygiene.

IN the British House of Commons, it was announced recently by Mr. Attlee, Lord President of the Council, that the government had decided to set up a Royal Commission to investigate the birth-rate and trends of population and that the Lord Chancellor had accepted the chairmanship. The terms of reference of the commission are to examine the facts relating to the present population trends in Great Britain; to investigate the causes of these trends and to consider their probable consequences; to consider what measures, if any, should be taken in the national interest to influence the future trend of the population and to make recommendations.

THE British Secretary of State for the Colonies, according to *Nature*, has appointed a Colonial Fisheries Advisory Committee to advise him on problems concerning fisheries (marine and freshwater) in the Colonial Empire, in association with his fisheries adviser. The committee is constituted as follows: The Duke of Devonshire, Parliamentary Under-Secretary of State for the Colonies, *chairman;* G. L. M. Clauson, Colonial Office, *vice-chairman;* Dr. S. Kemp, director of the Marine Biological Association of the United Kingdom; Dr. E. B. Worthington, director of the Freshwater Biological Association of the British Empire; Dr. E. S. Russell, fisheries adviser to the Secretary of State for the Colonies; Dr. G. A. Reay, director of the Torry Research Institute, Department of Scientific and Industrial Research, Aberdeen; Dr. B. S. Platt, in charge of investigations into nutrition in the Colonial Empire under the Medical Research Council; J. R. Norman, deputy keeper, Department of Zoology, British Museum (Natural History); Dr. C. F. A. Pantin, reader in invertebrate zoology, University of Cambridge; R. S. Wimpenny, naturalist, Ministry of Agriculture and Fisheries; J. Thomson, chief inspector of fisheries, Ministry of Agriculture and Fisheries; Morley Neale, member of the firm of Neale and West, steam trawler owners, Cardiff; C. N. Hooper, clerk of the Fishmongers Company, and R. H. Burt, Colonial Office, *secretary.*

DISCUSSION

THE COLLEGE CURRICULUM IN WARTIME AND INTRODUCTORY COURSES IN BIOLOGY

REPORT Number 15, on "Adjustment of the College Curriculum to Wartime Conditions and Needs," recently issued by the U. S. Office of Education, is to me a most disturbing and puzzling document. Although the Office of Education assumes no responsibility for the statements in the report, attributing them to the committee named in it, publication by this agency will, obviously, give the report a stamp of authority to which it is not entitled. Furthermore, it is hard for me to believe that all the statements in the report have the unanimous endorsement of the committee.

The committee concluded, quite wisely it will seem to most biologists, that it should "not recommend wartime modifications as such in the beginning college courses" (in the biological sciences). Wartime modifications actually have been made by some of us in con-

formity with a fixed course of study, *e.g.*, the Navy V-12, but this has been done temporarily, and in spite of a conviction that the new curriculum may be less satisfactory for the student than the one replaced. The bulk of the report does not deal with this matter, however, which was within its province, but rather with a presentation of positive views on a controversial matter which the committee does not succeed in relating to wartime as contrasted with peacetime conditions.

The principal conclusion of the committee is that courses in general biology are not satisfactory for beginning students. Separate courses in botany and zoology are recommended, the committee concluding that either one alone is better than general biology. The report fails to recognize the fact that general biology is actually successfully taught in a number of institutions among the best academically in this country. The report does not mention any of the inherent advantages that a general biology course has over separate courses in botany and zoology. It appears to me, in fact, that the committee prejudged the issue; the point of view of general biology is as completely ignored in the report as if it were non-existent. Furthermore, the report is worded in such a way that the committee's disapproval of general biology courses appears by insinuation even in those statements not directly expressing an evaluation. This is illustrated in the quotations from the report which follow.

The gist of the committee's finding is to the effect that: "There is no objective evidence available to the Committee to show that general biology (beginning courses) is as good or has any advantage over well-organized courses of general botany or of general zoology. There is subjective evidence and some objective evidence that general botany and general zoology have greater value to the students than the general biology covering the two great fields." The report defines various kinds of general biology courses in such a way that botany and zoology courses are certain to gain by comparison. The implication of the report is that botany and zoology are independent sciences ("great fields"), and that biology is not a great field of science but merely the result of an addition of piecemeal segments of these. It would be interesting to compare the categories distinguished in this report with lists prepared by other committees with quite different points of view; we would probably find little evidence for objective validity in the classification, and probably none for some of the details of the definitions. In any case, if all the categories here given are to be called general biology in a formal report the name might better be enclosed in quotation marks. It is true that many types of courses go by this name and that many of them are not general biology; it is not equally true, however, that they are all unsatisfactory.

According to the report:

> . . . the courses in general biology are constructed as follows:
>
> 1. Introductory zoology (often quite limited in scope and without field work).
>
> 2. Seventy to ninety per cent. zoology with a small amount of botany, and usually taught by men and women trained in zoology. Entomology and fundamental physiology are often omitted.
>
> 3. Courses with about half animal and half plant illustrations but without sequential arrangement that leads to good understanding of either plants or animals or to the applications of the studies. Usually taught by zoologists.
>
> 4. A half year of botany followed by a half year of zoology with the zoology using the previous training in botany as the starting point for the second semester's work; this organized as a sequential whole and the botany and zoology taught by men well trained in botany and zoology.

A much more objective and more complete estimate of the weaknesses of general biology courses was made by Professor George E. Nichols.[1] His paper is very valuable as a guide to the difficulties of conducting courses in general biology.

Note under the third category above the statement "usually taught by zoologists"; that was the favorite criticism of certain botanists of a generation ago, biology having been referred to as "botany taught by a zoologist." The statement does not suggest that there is such an individual as a person with a broad biological point of view, but rather that biologists are all, of necessity, either botanists or zoologists. Elsewhere the report implies that an individual well trained in both botany and zoology is indeed rare. That individuals sufficiently well trained to direct advanced work in both botany and zoology are rare may be true, but that those trained for the purpose here implied are rare, I doubt. Certainly, considering the number of individuals who are quite competent in both a physical and a biological science, there is no inherent reason for such narrowness.

I am unable to understand what is meant by the phrase in the description of category three "without sequential arrangement." A taxonomic arrangement is implied under number four, and this seems desirable to the committee. A taxonomic approach in general biology, however, is quite unsound as well as wasteful of time; but a logical arrangement of another kind is quite essential. In general biology, plant and animal materials are considered in relation to metabolism, behavior, reproduction and development, heredity, evolution and distribution, not primarily in relation to morphological patterns. The fundamental con-

[1] SCIENCE, 50: 509–517, 1919.

cepts of biology are better taught thus. That is why exponents of a well-organized general biology course believe that it has advantages over separate courses in botany and zoology ("well-organized" or not), or over a combination of the two if there is not more integration than is usually attempted. The fourth category is not general biology at all, but a short course corresponding to the committee's recommendation. The committee has not recognized in practise what it does admit in theory, *viz.,* "that the same fundamental laws of life apply generally to all organisms." It is unfortunately true that most text-book writers have failed to produce a text-book built upon this underlying concept. Such writers are still bound by tradition and circumstance, most so-called general biology text-books being poorly integrated accumulations of botanical and zoological facts. One text that stands out as an example of what should be done on a wider scale (Plunkett's "Outlines of Modern Biology") remains one of the most widely praised but least used of the group.

Much of the force of the report lies in its reiteration of its central theme. This occurs again in Part II of the committee's report, worded, however, even more positively than before: "If there is objective evidence or sound subjective evidence that general biology courses have lasting value for the students, it has not been made available to this committee." I do not know what would constitute "sound subjective evidence"; I only know that I would hesitate to question the existence of evidence, objective or subjective, for the lasting value of any course for any students. Surely, some of the thousands of non-science students who listened to Professor Conklin's lectures in general biology at Princeton, but who went no further in biology, derived some lasting benefit. The record has been similar in other American colleges and universities, Stanford, Chicago, Yale, New York University, to name a few. I for one refuse to admit that this concept of a science of biology, introduced to America by an eminent Englishman nearly seventy years ago, should now be abandoned in the organization of introductory courses in biological science. We need more, rather than fewer, introductory courses in which there may emerge in the student's mind a concept of a unified science of life.

GORDON ALEXANDER

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A POISONOUS PEA CONTAMINATE

THE synonym "nightshade" is applied to the various species of the genus *Solanum*. Black nightshade, *S. nigrum* L., is one of the most cosmopolitan of the wild plants, extending over the entire globe. Yellow nightshade, *S. nigrum* var. *villosum* L., *S. villosum* Lam. or *S. luteum* Mill., has been found in Europe but grows mostly in the United States. Cut-leaved or three-flowered nightshade, *S. triflorum* Nutt., is a native of the Great Plains and Rocky Mountain region of the United States. All three of these nightshades are found in the Inland Empire, a section covering eastern Washington, northern Idaho and extreme northeastern Oregon.

Nightshades have become of late a serious problem to the pea industry. Many canneries have had difficulty in separating the nightshade berries from the peas. Both mature at the same time and are approximately the same size. The Food and Drug Administration prohibits the sale of peas which are adulterated with nightshade berries. This act has been questioned, because some do not consider the berries toxic but actually look upon them as a food. Doubt as to the toxicity of the yellow and three-flowered nightshades is justified considering that very little or no scientific data have been published on this point. The black nightshade was shown to contain a poisonous substance, solanine, first by Desfosses in 1821. Ecological factors cause a great variation in solanine content of all plants containing it. No quantitative data have been published on the solanine content of these plants found growing in the Inland Empire.

Work in the laboratories of the School of Pharmacy, State College of Washington, which is in progress, has reached the point where the toxicity of *Solanum triflorum* can be definitely stated. Solanidine has been indicated by qualitative test in *S. nigrum* var. *villosum* and has been isolated from the fruit of *S. triflorum*. This indicates that these species of *Solanum* are toxic, but the data concerning the amount of the toxic substance present will have to wait until work in progress has been completed.

COY W. WALLER

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MERCURY IN DRAIN PIPES

RECENTLY we had occasion to clean out the drain pipe of one of our laboratory sinks and found, among other things, about a quarter of a pound of mercury trapped in the drain elbow. This quantity probably represents several years' accumulation. I recollect having similar experiences in the past and suspect a similar condition exists in the drains of most of the scientific laboratories in the nation. Might I suggest the exploration of this possibility as a means of adding a significant quantity of this vital metal to our nation's stores?

SYDNEY C. RITTENBERG

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SCIENTIFIC BOOKS

APPLIED MATHEMATICS

Quarterly of Applied Mathematics. Under the sponsorship of Brown University. Vol. I. Number 1, April, 1943. Number 2, July, 1943.

THE first scientific journal entirely devoted to applied mathematics, *i.e.*, to the applications of mathematics in other branches of science and to the development of mathematical methods suited for this purpose, was founded in Germany in 1921. It has been known as the *ZAMM* (*Zeitschrift fur angewandte Mathematik und Mechanik*) and was published by the Verein Deutscher Ingenieure, the German Engineering Society. This enterprise was an outcome of the long-continued efforts of Felix Klein, the famous mathematician of great productive power who devoted a considerable part of his lifetime to the task of placing the cultivation of mathematics in Germany on a sounder basis. For some historical reasons, in Germany, unlike other countries, engineering sciences had never been admitted to the universities, but were taught at strictly separate institutes of technology. The mathematicians teaching at the university were in permanent contact with physicists, chemists, etc., but almost entirely unfamiliar with engineering problems, which more and more required the application of advanced mathematical theories, as had been the case in physics for a longer period. Under the influence of Felix Klein chairs of "applied mathematics" were created at several universities, and the *ZAMM* was intended to serve as a further bridge between the university people and those interested in engineering research at the Technische Hochschulen. This explains the somewhat illogical conception of "Angewandte Mathematik und Mechanik," which emphasizes mechanics and practically excludes physics, although physics is obviously the principal and most important field of application of mathematical ideas.

The pattern set by the *ZAMM* was then followed in several other countries. In Russia, where the educational institutions are similar to those in Germany, a journal was founded in 1933 under the same title. It was later taken over by the Russian Academy of Science and is to-day by far the best periodical in this field, assembling papers of high originality and intrinsic value. In the same year a group of members of the American Society of Mechanical Engineers started the *Journal of Applied Mechanics,* which actually covers the major part of the subjects dealt with in the *ZAMM*. Two other American magazines concerned with special branches of applied mathematics must be mentioned here. In 1933, likewise, the Institute of the Aeronautical Sciences began publication of a scientific journal, which under the able leadership of J. C. Hunsaker developed into one of the foremost aeronautical publications covering all problems of fluid mechanics, dynamics and stress analysis connected with aviation. Three years earlier the Institute of Mathematical Statistics had started publishing its *Annals,* a high-ranking magazine devoted to research papers in probability and theoretical statistics on an advanced level.

Thus the situation regarding publishing facilities in applied mathematics was very different now in this country from what had been the case in Germany twenty-two years ago. First, the sharp contrast between mathematicians and physicists on one side and engineers on the other has never existed in America (nor did it in England). Secondly, care had already been taken, in a rather ample measure, of special branches, particularly of those related to mechanical engineering. Nevertheless, a distinct demand has been widely felt for a new avenue of publication, owing to the peculiar character of the research work as favored at present by American mathematicians. Except for a few outstanding men of the older generation, like Birkhoff and Veblen, the mathematicians here are almost exclusively concerned with the most abstract parts of mathematics. No geometry but topology, no analysis but theory of sets, no algebra but abstract algebras are the largely preferred subjects at meetings and in the magazines. Classical mathematics which developed for centuries in close relationship to physics are treated with a kind of disdain. In this way a new gap has been created, with the mathematicians on one side as opposed to all the people who apply mathematics, in physics and chemistry, in engineering, in statistics and economy, in biology, etc. What is needed to counterbalance this unfortunate state of affairs are efforts in a definite direction—one has to concentrate on the general aspects of applied mathematics without emphasizing any particular branch or subject, and in doing so to feel responsible for the advancement of all parts of classical mathematics, so badly neglected by the "pure" mathematicians.

It does not make the impression that the group at Brown which undertook to start the *Quarterly of Applied Mathematics* has chosen to follow this line. It seems that what they had in mind was not unlike another *ZAMM,* with a more restricted program. On the inside cover the editors simply ask for papers "which have an intimate connection with application in industry or practical science," and the whole program is focused on "tooling up mathematics for engineering." Papers on probability, statistics, economy, biology seem practically excluded. Theoretical physics and chemistry, the paramount fields of application, are not mentioned. In the board of editors, which includes Th. von Kármán, leading man in aeronautical

research, none of the country's representative mathematicians is listed. In the first two issues at least 90 per cent. of all articles are concerned with problems of mechanical engineering, and most of them could have been published in either *Applied Mechanics* or *Aeronautical Sciences*. There is of course no objection against duplicating existing facilities as long as care is taken not to lower the existing level. But it is one thing to grow a new variety in order to adorn one's own garden and another thing to fill a widely felt need and to serve a far-reaching purpose of common interest. Now it may take a long time before such a journal as had been hoped for will materialize.

Each one of the first two issues includes an expository article, both of high value. H. L. Dryden reports on the modern theory of turbulence, and it is very interesting to realize the progress made since, ten years ago, the *Journal of Applied Mechanics* started its first issue with a review on the same subject. In the second issue K. O. Friedrichs and J. J. Stoker outline some aspects of non-linear mechanics in a particularly comprehensible form. The most interesting contribution so far is undoubtedly the paper of L. Bers and A. Gelbart, on certain differential equations in mechanics. It has been known for a century that the problem of finding the two-dimensional potential flow of an incompressible fluid can be solved by means of complex variables: To each analytic function of a complex variable corresponds a particular solution of the potential problem and *vice versa*. Several years ago Stefan Bergman discovered that essentially the same is true for a vast class of partial differential equations which includes the potential equation as the simplest case. Bergman gave explicit formulae which allow a solution of a given differential equation to derive from an arbitrarily chosen analytic function (in some instances from a pair of real functions) and proved that all solutions can be derived in this way. Now, two of Bergman's pupils, Bers and Gelbart, found that in a special case the analogy can be carried much farther. They consider a special type of differential equation, yet more general than the potential equation, and build up a system of solutions in close analogy to the procedure followed in the theory of analytic functions. Fortunately, this restricted type includes the problem of a two-dimensional flow of a compressible fluid which is to-day in the center of interest in aviation. Though all solutions obtained by Bers and Gelbart can be derived by Bergman's methods also, it must be expected that the new approach will prove very useful.

The quality of papers in a magazine can not possibly maintain a uniformly high level and a large allowance must be made for unavoidable deficiencies. In the second issue a kind of mischief happened with an article on the flow around an airfoil with flap. The author tries to compute the point on the flap where the flow separates, forming a dead-air region. But he overlooked that according to the very formula he applies the flow must have already separated at the corner before reaching the flap at all. If the corner is rounded off, the separation point will travel along the flap and its position will be determined by the radius of curvature so that the proposed solution, also in this case, gives no answer to the real problem.

Such an accident must not be taken too seriously and by no means blamed on the editors. On the contrary, it is the opinion of this reviewer that many editors feel too often inclined to act like schoolmasters examining the papers submitted for publication as though they knew all answers beforehand. This teacher-to-pupil relation takes a particular form in the *Quarterly*, where a large number of articles are marked as "suggested" or "encouraged" or "directed" by an editor. That more of this must be expected can be concluded from an article in the *Mathematical Monthly*[1] in which Dean R. G. D. Richardson, of Brown University, illustrates the background of the new magazine. The author proudly reveals that "more than twenty-five research papers have been completed" within a short period in the School of Advanced Mechanics at Brown. It seems that here the borderline between research work and the type of results which usually grow out of the problem sections in a graduate school is somewhat misplaced. In fact, nothing would be more detrimental for the development of applied mathematics as a genuine branch of science than to propagate the idea that in this field papers can be turned out to order. History has taught that the best, if not the only, way to promote scientific achievements is to leave people who are able to do creative work to themselves and to protect them as far as possible against all kinds of organizers and inciters.

All this criticism should not discourage a reader who wants to be currently informed about certain aspects in the progress of engineering mathematics. He will certainly find much useful and interesting material in good shape. Nor is the criticism meant to underrate the merits of the men who have spent considerable time and labor to create the new periodical and to keep it going. After all, there are many roads that lead to the same goal and nobody knows which is the best. Brown University has undoubtedly made great sacrifices in bringing forth the journal at the present time and under actual difficulties. The format is irreproachable. If wisely conducted, the *Quarterly of Applied Mathematics* will achieve a notable place among the other American publications in this field.

RICHARD VON MISES

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[1] *Math. Monthly*, Vol. 50, p. 415, 1943.

SPECIAL ARTICLES

MAMMARY CANCER AND MAMMARY STRUCTURE IN INBRED STOCKS OF MICE AND THEIR HYBRIDS[1, 2]

GARDNER and Strong[3] used the whole mount technique to study the structure of the mammary glands in virgin females of several stocks of mice, including the A and C3H strains, and could not detect any difference in the architecture. Also, the inherited tendency for spontaneous mammary cancer was not found to be associated with any change in the structure of the glands. In a later publication, Gardner, Strong and Smith[4] observed the presence of localized hyperplastic nodules in glands of animals from strains in which mammary cancer frequently resulted. Few, if any, of the nodules were found in the glands of mice from low cancerous stocks.

Taylor and Waltman[5] stated that the essential difference in the structure of the glands from mice of the cancerous dilute brown stock and low cancerous C57 black strains was in the number of acini (hyperplastic nodules) found in glands of mice of the cancerous strain. This difference persisted following the injection of estrogenic hormones. Using the same strains, van Gulik and Korteweg[6] concluded that in virgin females an architectural difference in the structure of the primary ducts and the gland-trees could be found. The F_1 hybrids, produced by reciprocal matings, had glands whose primary ducts were characteristic of the maternal strain, while the gland-trees resembled the maternal type but were modified in the direction of the type found in the paternal strain. They believed the hyperplastic nodules to be associated with the active milk agent.

Loeb and Suntzeff[7] stated that one of the factors determining the difference between mice of various strains toward the development of mammary cancer was the readiness with which the glands gave progressive growth to stimulation by estrogens.

MATERIAL AND METHOD

To determine what the incidence of mammary cancer might be in hybrids, reciprocal matings were made between mice of the cancerous A and C3H stocks. The hybrids have been maintained either as virgin or breeding females, but only the former are considered in this report. In addition to the incidence of mammary cancer, the architecture of the mammary glands was studied by the whole mount technique.

Virgin females of the A stock have a low incidence of spontaneous mammary cancer,[8] whereas non-breeding females of the subline of the C3H or Z stock used in these experiments frequently develop such tumors.[9] Breeding females of each strain have a high incidence of mammary tumors.[10]

The oldest animals have attained the age of 14 months, but because the youngest mouse to become cancerous did so at approximately 9 months of age, only mice which have reached that age will be mentioned.

The animals are receiving Purina Fox Chow and an unlimited amount of water.

RESULTS

In previous experiments, virgin females of the A stock had an incidence of mammary tumors of 4.9 per cent.,[11] whereas virgin females of the C3H or Z stock gave an incidence of 72 per cent.[9] (and unpublished). The number of mice observed was 223 and 51, respectively.

The number of mice being observed at present is given in Table 1, together with the number in each group living to be 9 months or older. The incidence of mammary cancer was determined from the number of mice which had survived for at least 9 months. To date, few animals have died without cancer.

TABLE 1

Stock	Number under observation	Number surviving for 9 months or longer	Cancer incidence for virgins living 9 months or longer
A	101	55	0 per cent.
Z or C3H	104	7	43 " "
AZF_1	121	47	45 " "
ZAF_1	65	10	20 " "

AZF_1 hybrids were produced by mating females of the A stock with males of the Z or C3H strain; the ZAF_1 hybrids were derived from the reciprocal cross. From Table 1 it will be seen that mammary tumors are being recorded in virgin females of the Z or C3H stocks and their reciprocal hybrids; to date none of the virgin females of the A stock has had tumors. (Our earlier studies showed an incidence of 27 per cent.[9] spontaneous mammary tumors in C3H virgins at 9 months.)

The mammary glands of mice from the inbred stocks

[1] Preliminary report.

[2] Assisted by the University of Minnesota Graduate School Cancer Research Fund and The Jane Coffin Childs Memorial Fund for Medical Research.

[3] W. U. Gardner and L. C. Strong, *Am. Jour. Cancer*, 25: 282–290, 1935.

[4] W. U. Gardner, L. C. Strong and G. M. Smith, *Am. Jour. Cancer*, 37: 510–517, 1939.

[5] H. C. Taylor, Jr., and C. A. Waltman, *Arch. Surg.*, 40: 733–820, 1940.

[6] P. J. van Gulik and R. Korteweg, *Proc. Nederl. Akad. van Wetenschappen*, 43: 891–900, 1940.

[7] L. Loeb and V. Suntzeff, *Arch. Path.*, 32: 739–759, 1941.

[8] J. J. Bittner, *Pub. Health Rept.*, 54: 380–392, 1939.

[9] M. B. Visscher, Z. B. Ball, R. H. Barnes and I. Sivertsen, *Surgery*, 11: 48–55, 1942.

[10] J. J. Bittner, *Cancer Research*, 2: 710–721, 1942.

[11] J. J. Bittner, *Pub. Health Rept.*, 54: 1113–1116, 1939.

and their hybrids have shown minor variations in their architecture when studied by the whole mount technique. These findings will be presented in another report when more data are available.

Hyperplastic ("precancerous") nodules were found in the glands of virgin females of the C3H stock and the AZF_1 and ZAF_1 hybrids which had reached the age when mammary cancer might be expected to develop. The nodules were more numerous in the glands of the hybrid mice than from the C3H animals. They were also found in the glands of mice of these groups which had not developed cancer but had survived to the cancerous age.

The glands from a few virgin females of the A stock of the same age did not have any hyperplastic nodules.

In addition to the virgin females, the glands of fostered breeding females of the A and C3H stocks were examined. All the females had given birth to at least 3 litters and ranged in age from 11 to 16 months. Only occasionally a nodule was found and never more than one to a gland.

Discussion

Spontaneous mammary cancer in mice will develop only in glands which have been stimulated to growth by estrogenic hormones. Although the virgin females of the A stock develop very few mammary tumors,[8] their mammary glands appear to be as well developed —except for the absence of hyperplastic nodules—as are the glands of the virgin females of the C3H stock in which mammary tumors frequently are found.[9]

The differences producing these incidences of cancer between virgin females of the A and C3H stocks appear to be explicable most satisfactorily on the supposition that they are due to characteristic differences in hormonal metabolism, in a broad sense, in mice of the two strains. This deduction finds its strongest support in the fact that repeated pregnancies in females of the A strain brings the incidence of mammary cancer in the latter to that in the C3H mice.[10, 12] If this supposition is correct it would be deduced that a difference in the virgin state in (a) the amounts of estrogen produced or available for action on the mammary glands, or (b) the sensitivity of those structures to estrogens, or a combination of both, would be responsible for the strain difference observed.[11] Whatever the cause (or causes) may be, these data suggest that the effect is controlled by intrinsic factors since the first generation hybrids with C3H fathers and mothers from the A stock have developed spontaneous mammary tumors when maintained as virgin females. It can further be inferred that this characteristic difference in the production of mammary tumors in virgin females of the A and C3H stocks is inherited as a dominant character.

The entire problem of the nature of "inherited susceptibility" is brought to the fore by these observations. It is not possible to analyze all the factors involved in detail at this time, but the observations reported indicate that at least one physiological character determined genetically operates through a hormonal mechanism. It is doubtful whether this inherited hormonal character corresponds completely with the "inherited susceptibility for spontaneous mammary tumors"[13] as previously described.

No correlation could be detected between the presence of the hyperplastic nodules or precancerous lesions and the active milk agent alone. The virgin females of the A stock have this influence and nodules were not found in the small number of glands which were examined. However, the nodules were found in virgin females which had the active milk agent and the inherited estrogenic factor, as the virgin C3H females and of the reciprocal hybrid generations. That the nodules usually do not result from the estrogenic stimulus alone was suggested by the small number of them found in the glands of fostered breeding females of the A and C3H stocks. These mice did not have the milk agent, but the estrogenic influence would be greater, because of the production of young, than one would expect in virgin females. In these mice the inherited estrogenic stimulus would be supplemented by the extrinsic (breeding) stimulus. The fostered breeding females of these stocks have a low incidence of mammary cancer.[10]

Thus, the tentative theory may be advanced that the hyperplastic nodules result from the inciting influence of both the active milk agent and the estrogenic hormones[14] and not solely from the action of the milk agent, as suggested by van Gulik and Korteweg.[6]

Conclusions

Characteristic differences in hormonal metabolism in virgin females of inbred strains of mice may result from: (a), the amounts of estrogen produced or available for the stimulation of the mammary glands, and/or (b), the sensitivity of the mammary glands to estrogenic hormones.

The inherited estrogenic influence is transmitted as a dominant and plays a role in the genesis of spontaneous mammary tumors in virgin females of inbred strains and their hybrids.

The inherited estrogenic influence is probably not identical with the "inherited susceptibility for spontaneous mammary cancer."

Hyperplastic or precancerous nodules in the mam-

12 J. J. Bittner, *Cancer Research*, 3: 441–447, 1943.

13 Females of the A stock transmit the inherited susceptibility for spontaneous mammary tumors to their hybrids, but tumors do not result unless the females are used as breeders; unless an extrinsic source of esterogens is obtained.[11]

14 Nodules have been found in breeding females of the non-susceptible C57 black stock which had received the active milk agent by foster nursing.

mary glands of mice probably result from the inciting influence of the mammary tumor milk agent and the estrogenic hormones.

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AEROSOL, A NEW METHOD OF APPLYING GROWTH REGULATORS TO PLANTS[1]

L. D. GOODHUE[2] found the aerosol method to be an excellent and efficient one for dispersing certain insecticides. One method of producing aerosol involves the use of a highly volatile liquid carrier in which the insecticide is dissolved either directly or after it has been dissolved in some other solvent. The solution of carrier, solvent and insecticide is contained under pressure in a suitable receptacle from which it can be released as a mist. The carrier immediately volatilizes, leaving the insecticide suspended in the air in an exceedingly finely divided liquid or solid state. This method of applying insecticides suggests a new means of applying growth substances to plants for the purpose of modifying development, such as delaying opening of buds, preventing abscission of flowers and fruit and aiding fruit setting. Preliminary results indicate that the method may prove of much value for such applications.

An experiment was designed to determine the effectiveness of a growth substance in setting seedless fruit on tomatoes, when dispersed as an aerosol form. For this purpose three grams of naphthoxyacetic acid were dissolved in 27 grams of cyclohexanone. This solution was placed in a steel cylinder into which 270 grams of di-methyl ether was then forced under pressure.

Ninety-six Pan America tomato plants were grown under greenhouse conditions until the first blossoms of the first cluster had opened. One half of the plants were kept in the greenhouse as controls and the remainder were held for 16 hours in an air-tight room into which aerosol containing naphthoxyacetic acid was released. The naphthoxyacetic acid was dispersed at 240 mg per 1,000 cubic feet. The plants were then taken back to the greenhouse and allowed to grow under the same conditions as the control plants. Three days later fruit enlargement was observed upon the treated plants and none upon the controls. Nine days after treatment the average number of fruit set per plant for the first cluster was 3 for the treated plants and 0.5 for the controls. The average diameter of fruits after 36 days was 2.9 inches for the treated plants and 2.1 for the controls. Ten fruits collected at random from the treated plants were all seedless.

Thirty-two additional tomato plants treated in the open air have also set fruit. In this experiment the cylinder was held at a distance of one foot from the plant and the valve was opened for about one second. The mist covered the flower cluster but was quickly carried away from it by air currents. The plants were then returned to the greenhouse. The number of fruits set per plant in the treated lot was comparable to that obtained in the first experiment. The controls in this instance failed to set fruit.

Further studies are under way to test field applicability of this method and to test various other growth substances. Tests will also be made to determine quality of the fruit developed.

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[2] L. D. Goodhue, *Ind. and Eng. Chem.*, 34: 1456–1459, December, 1942.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SPRING-PRESSURE-CONTACT ELECTRODE FOR USE IN ELECTROENCEPHALOGRAPHIC RECORDING[1]

WITH the widespread use of the electroencephalograph to survey large populations in both military and civilian medicine and with an increased difficulty in obtaining technicians for this work, it has seemed necessary to devise a fast, simple technique of electrode application.

Since Berger reported the recording of electrical potentials from the human brain by means of silver wires inserted into the anesthetized scalp, electroencephalographers have sought more efficient ways of electrode application.[2, 3, 4, 5, 6, 7, 8] Concerning the

[1] From the Department of Anatomy, University of Oregon Medical School. The work described in this paper was done under a contract, recommended by the Committee on Medical Research, between the Office of Scientific Research and Development and the University of Oregon Medical School.

method at present most commonly used, namely, the application of small solder pellets to the scalp with collodion, it has been stated that "No one should consider himself trained in this procedure, until he has applied at least three hundred electrodes."[5] It has been our experience that this is a conservative estimate and that the training of new technicians, together with the length of time required for electrode application and the artifacts caused by the loosening

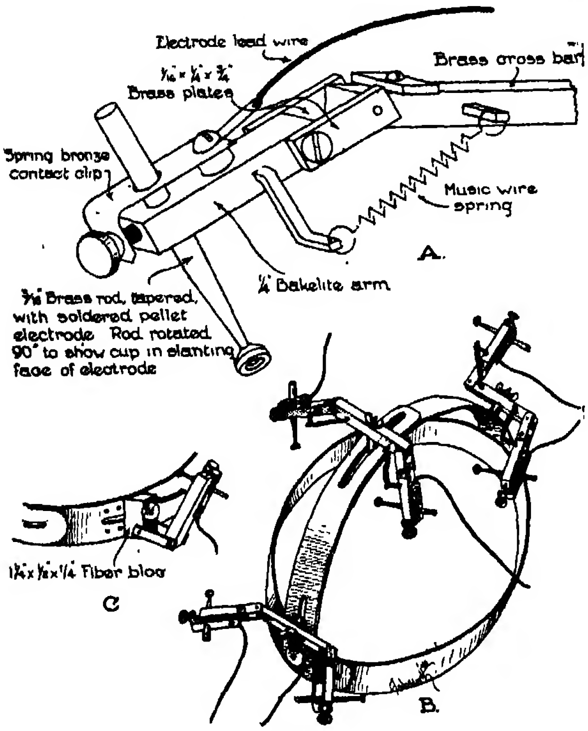

FIG. 1

of such electrodes when improperly applied, make this method quite unsatisfactory.

Hence a method of spring-pressure-contact electrode placement was developed which has, in our hands: (1) substantially lessened the time required for electrode application; (2) obviated the necessity for long practice in electrode application; (3) dispensed with the collodion so often objectionable to the patient, and (4) aided in the comparison of EEG records from patient to patient by permitting a more uniform electrode placement.

[2] H. L. Andrews, *Am. Heart Jour.*, 17: 599–601, 1939.
[3] A. Baudouin, H. Fischgold and J. Lerique, *Compt. rend. Soc. de biol.*, 127: 1221–1222, 1938.
[4] C. W. Darrow, *Proc. Soc. Exp. Biol. and Med.*, 45: 301–302, 1940.
[5] F. A. Gibbs and E. L. Gibbs, "Atlas of Electroencephalography." Cambridge, Mass.: Lew A. Cummings Co. 1941.
[6] H. H. Jasper and H. L. Andrews, *Jour. Gen. Psychol.*, 14: 98–126, 1936.
[7] A. E. Kornmüller and R. Janzen, *Zeit. ges. Neurol. Psychiat.*, 166: 287–308, 1939.
[8] W. G. Walter, *Lancet*, 2: 305–308, 1936.

Fig. 1a shows one of the electrode assemblies. The electrodes are short sections of brass rod tipped by shallow solder cups. They are freely adjustable, yet held firmly in place by a set-screw as they pass through holes in the bakelite arm and spring bronze contact clip. The continuity of the electrical circuit is maintained by pressure of the spring bronze clip against the set screw. The bakelite arm is hinged to the cross bar (Fig. 1a) or other holder (Fig. 1c), by means of a pin through two small brass plates. The tension of a 0.013-inch piano-wire spring holds the electrode in the "up" position when not in use (Fig. 1b) and furnishes tension for keeping it against the scalp when recording is in progress. Thick electrode paste is placed on the tip of the electrode and rubbed into the scalp prior to making contact.

A fiber headband with adjustable members can be cut from a 1/16-inch fiber sheet or obtained from an electric arc welder's supply house in the form used for supporting a welder's hood. Bolts fastened through slits cut in the top and side of the band allow for free movement of the electrodes in an antero-posterior direction. In the routine 6 electrode holder (Fig. 1b) three cross bars of convenient lengths hold pairs of symmetrically placed electrodes which are movable over the frontal, parietal and occipital regions of the scalp. In a 16 electrode holder (useful for localization of intracranial lesions), five of these movable cross bars on the center band are supplemented by six individually mounted single electrodes, which, as shown (Fig. 1c), are movable along the sides of the headband and permit recording from lateral regions of the head.

Records are most conveniently taken with the patient in a sitting position. Recording in the supine position is possible with the use of a block pillow placed beneath the neck and base of the occiput.[9]

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[9] The authors wish to express their thanks for helpful criticism and suggestions from Dr. Robert S. Dow and Dr. Knox Finley, of the University of Oregon Medical School.

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THE ADVANCEMENT OF LEARNING IN THE UNITED STATES IN THE POST-WAR WORLD[1]

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IT is a great honor to have the privilege of giving the Franklin Medal lecture. The subject I have chosen is highly academic, but for this I offer no apologies to a distinguished audience. The matters which I shall treat are primarily of concern to scholars, yet, as I shall attempt to demonstrate, their implications affect the lives of all the citizens of this republic. And conversely, the attitudes and actions of the lay public will determine to no small degree the future of the world of scholarship. In short, my remarks to-night are in the nature of a footnote—an American footnote—to a discussion of the problem of the relation of society to scholarship, or, if you will, of the scholar to the nation.

[1] Franklin Medal lecture, given at the American Philosophical Society, Philadelphia, November 19, 1943, in a Symposium on the Organization, Direction and Support of Research. *Proceedings*, Am. Philos. Soc., Vol. 87, No. 4.

I

It is clearly impossible to discuss the advancement of learning in the United States without making some assumption as to what these United States will be like in the next two decades. For example, if by some miracle Hitler should succeed in forcing a stalemate, the omens would not be auspicious for the advancement of learning or for many other human activities—quite the contrary. We should be living in an armed camp, the authority of the Federal Government would be paramount and the national policy would be largely determined by military necessity. Except in certain specialized fields, knowledge would not advance. Similarly, if a period of social crisis were to be followed by a highly regimented society, the advancement of learning would soon fail to prosper. Under such conditions, whether the strong arm of govern-

ment were swung from the right or from the left, the effect would be the same; an official doctrine would cast an ominous shadow of fear over all discussion; dogma would take the place of free inquiry.

There is no need to labor the point. Those who have eyes to see or ears to hear know what has taken place across the oceans, and they tremble when they visualize the impact of society on science, or rather they tremble when they realize the effect of the impact of certain types of society on science and learning.

But history shows us that it is not only modern totalitarian societies which put learning in a strait-jacket. There are insidious poisons which may arise from every pore of the social structure and without benefit of the police or a "party line" suffocate the human urge to know and to understand. I venture to remind you of Gibbon's classic description of the highly stratified society of Byzantium:

> They held in their lifeless hands the riches of their fathers, without inheriting the spirit which had created and improved that sacred patrimony: they read, they praised, they compiled, but their languid souls seemed alike incapable of thought and action. In the revolution of ten centuries, not a single discovery was made to exalt the dignity or promote the happiness of mankind. Not a single idea had been added to the speculative systems of antiquity, and a succession of patient disciples became in their turn the dogmatic teachers of the next servile generation.

If the United States of the 1950's and 1960's is on the road to a civilization like that of the Byzantine Empire or like that of certain totalitarian nations in the 1930's, there is no use in discussing the advancement of learning. For the phrase no longer has the meaning given to it by Francis Bacon; it no longer carries those implications which have raised the hopes of countless men and women who have echoed his words through more than three centuries of ever-increasing liberty.

There can be no escape from the conclusion that if we are to talk about the advancement of learning, we must postulate the continuance of a free society. Can we accept such a postulate for the United States in the years ahead? I believe we can without hesitation. I say this in spite of the apprehension of many (which I share) as to the effect of the trend of this century towards collectivism, a trend reinforced by the demands of war.

I make this confident assertion as to the continuance of a free society because I believe we shall win not only the present war but the subsequent second battle for freedom. This second battle for freedom will start when the military might of Germany and Japan has been overthrown. It will be a battle not of planes or tanks or ships, a battle not of men against men but of a nation against threatened calamity. It will be the fight of a free people to continue along their historic line of development, a free people committed to the ideal of a fluid society with equal opportunity for all. It will be a fight to maintain a truly competitive system based on individual initiative arising afresh in each new generation. It will be a fight to make a competitive capitalistic system work in spite of the complexities of modern industrial life —to make it work, furthermore, in the face of the apparently overwhelming obstacle of the demobilization of a military undertaking which staggers the imagination.

I believe we shall win this second battle for freedom by keeping our blood pressure down and our chins up; we shall succeed by continuing the spirit of national unity achieved in time of war, by putting the nation's welfare ahead of personal desires, by clear and quick thinking on the part of experts and leaders alike even in the face of what some may proclaim to be "imminent disaster." And I believe we shall come out of this second battle for freedom without having witnessed the violence of revolution or counter-revolution and without having broken the continuity of our tradition.

We in the United States are the heirs of both the American and the French Revolutions. Nowhere else in the world have so many men for so many years acclaimed the ideals which are expressed by such phrases as: "liberty, equality, fraternity" and "life, liberty, and the pursuit of happiness." Nowhere else in the world have the slogans, "equality of opportunity" and "there are no classes in this country," expressed national ideals from which few ventured to dissent. Yet all who are not vainly trying to live in a past century know the force of a terrible question which has been raised throughout the western world— the question, how can these democratic ideals be in fact made a reality for the many, when vast economic power is wielded by a few. We shall evade this question at our peril. For it is only by facing it squarely that we shall find the answer; and it is only by finding the answer that we shall evolve a uniquely American civilization which will be, indeed, the promised land for those who would be adventurous and free.

II

Free inquiry—these words sum up, as well as any, the necessary condition for the advancement of learning in any age. The scholar must be free. He must be free both from intimidation and from control by government. He must inquire and speculate with as few restraints as possible. Yet history shows that the advancement of learning has not proceeded in a social vacuum. In those times when the advance has been

most spectacular, when groups of eager young men pressed forward in a new direction, there were strong forces at work which determined to some degree the objectives on which men of learning set their eyes. No one familiar with even the outlines of the record of the advancement of learning in the last three centuries can doubt that fact.

A controversy has been in progress during the last decade, however, as to the variety and kinds of social forces which have conditioned the behavior of scientists and scholars. This controversy stems from the application of the orthodox Marxist doctrine to a historical problem, namely, the relation of science to society. According to the Marxist view, "science is the product of the economic conditions of society, and its social function is to benefit the ruling classes of society." When applied to the work of Sir Isaac Newton, for example, this interpretation of the past leads to the somewhat startling statement that "Newton was the typical representative of the rising bourgeoisie, and in his philosophy he embodies the characteristic features of his class." Furthermore we are asked to believe that the scheme of physics with which he was concerned "was mainly determined by the economic and technical tasks which the rising bourgeoisie raised to the forefront." And the proponents of this twentieth century doctrine are ready to laugh out of court any who prefer a more heroic reading of the history of science; they will throw in their faces with a jeer Pope's famous lines:

Nature and Nature's laws lay hid in night;
God said "Let Newton be!" and all was light

But the sin of oversimplification may not lie entirely with the eighteenth century poet. This is made evident by a critique of the Marxist position from the pen of a distinguished historian, Professor G. N. Clark, in a small volume on "Science and Social Welfare in the Age of Newton." But the discussion continues. Two brilliant scientists of Great Britain line up on opposing sides. Bernal's "The Social Function of Science" is answered with vigor by Polanyi's "The Rights and Duties of Science" in his book, "The Contempt of Freedom."

As one interested in the history of science, I hope the debate will continue. But it seems evident that the economic interpretation of the history of science no less than the economic interpretation of general history can be pushed to absurd and extravagant lengths. The progress of pure science, for example, has been clearly in part a response to utilitarian stimuli. However, it is easy to show that this is not the whole story. Even the relation of science to industry, for example, is a highly complex affair. As I suggested here in Philadelphia last winter, neither the scientist nor the industrialist has been a parasite, the one living on the other. Rather, we are dealing with a case of symbiosis. If this be so, the healthy advance of physics and chemistry in the future will be assisted by a clear recognition of the symbiotic relation which these sciences bear to progress in technology.

Even when we consider only the field of experimental science, it seems evident that social forces other than economic have played an important role in relatively recent times. For example, the foundation of the Royal Society was closely connected with English Puritanism during the Cromwellian period. One can even make a very plausible case, following the lead of Max Weber, for a relationship of cause and effect between dissenting protestantism in general and the urge to follow Bacon's advice and advance learning for both godly and material reasons.

If the scientific movement in England in the seventeenth century came largely from dissenting and rebellious quarters, English scholarship in the field of history after the Restoration was the beneficiary of the opposing current of orthodoxy and loyalty to the Sovereign. A concern for the historical foundation of the Anglican church and doctrines led a number of ardent royalists to become great scholars. But this type of motivation is, of course, a recurrent factor in the history of scholarship. From the Middle Ages until the eighteenth century, theological controversy, philosophical inquiry, and the study of antiquity were almost inseparably interwoven.

In short, as we view the advancement of learning over a considerable span of time, the ivory tower seems conspicuous by its absence. The scholar may imagine that he is as free as a pioneer in a virgin forest, yet those who trace his wanderings from a distance can discern the effect of many varied social forces. Indeed, it would be my contention that certain types of strong social forces must play upon the world of scholarship if the spirit of learning is to live and flourish. Paradoxically, free inquiry must be powerfully polarized if inquiry is to prosper. This will be particularly true, it seems to me, in the highly industrialized age which lies ahead. For if free inquiry is but an aimless, leisurely ramble amidst delightful scenery, it is likely to become an occupation only for the old and intellectually infirm.

Professor Bernal warns that "whatever the scientists themselves may think, there is no economic system which is willing to pay scientists just to amuse themselves." I am not so sure. The cost accounting methods of a democracy are not as penetrating as he assumes. But I do feel sure that if one attempts to justify a scientific or scholarly activity solely in personal hedonistic terms, the effect on the incoming recruits will be disastrous. Is it not clear that if scholarship and pure science are to flourish in a democratic,

technical society, such enterprises must be alive and vigorous? Is it not evident that they must be a part and parcel of the great adventure of the day? Only then will the ambitious, energetic, and imaginative young men of each generation be attracted to the academic and learned world. And it is on the recruitment of the next generation of scholars, I may remind you, that the future of each age of scholarship depends.

From all this I am sure no one in the audience will dissent. A debate might well develop, however, if we were to try to distinguish more closely between those forces which may polarize the field of learning disadvantageously and those which are beneficial in their action. The Marxists among you, if there be any, would certainly make free use of the idea of social utility and would not be too much worried if society rather frequently demanded an accounting from the scholar in those terms. Others among you would both repudiate the validity of the test of utility and be shocked by any suggestion of an accountability of the world of scholarship to those who stand outside.

Personally, I view the question not primarily in terms of the degree of coercion of the scholarly by the masses; but rather as a problem involving the quality of the appeal that the scholar can make to the brilliant and enterprising sons and daughters of those who constitute the masses. And I think this appeal should be couched neither in utilitarian terms nor in those appropriate to a secluded retreat where the academic equivalent of the slogan, "art for art's sake," is the official doctrine. Rather, it seems to me that in each area of the entire field of learning the activities under way must be manifestly relevant to the future of our civilization. The undertakings must be relevant not only to man's physical and social needs but to his highest hopes and aspirations. Relevance, not utility, therefore, I submit is the touchstone to test the vitality and validity of a scholarly enterprise—relevance to the future as we envision it.

III

To illustrate how the relevance or lack of it in scholarly undertakings may be assessed, it is essential to deal separately with widely different types of intellectual activity. For this purpose the conventional academic divisions are quite unsuitable. Therefore, I propose to follow Francis Bacon in trisecting the whole field of learning, but to take great liberties with his definitions.

In the second book of the "Advancement of Learning," Bacon wrote as follows: "The parts of human learning have reference to the three parts of man's understanding, which is the seat of learning: history to his memory, poesy to his imagination and philosophy to his reason."

Three centuries of the very activity for which Bacon was pleading throughout his famous treatise have made his classification now inadequate. In the twentieth century we have a vast fund of knowledge accumulated by the labors of historians, archeologists, experimental scientists and observers of natural history. We roam freely in fields of which the author of the "Advancement of Learning" never dreamed. And we are confident that the process of expansion has far from reached the end. With Mr. Churchill we can believe that "the empires of the future will be empires of the mind."

Looking back over the journeys of the pioneers who opened the new vistas for us, we can speak with assurance of the advancement of learning. Indeed, here and there we can even hazard an opinion as to the rate of progress and complain about those times and places when it seems unduly low. Seen in historical perspective, many products of man's memory and reason must be classified together. From this point of view the labors of a dozen generations of experimental philosophers are clearly more closely related to archeology than to what is now embraced by the term philosophy. Mathematics, likewise, has undergone a similar development.

Bring back to life a student of antiquity of a century or two ago and confront him with the present status of archeology and ask him whether or not learning has advanced. Can there be any doubt as to his answer? Repeat the hypothetical operation in physics or biology or mathematics and ask the early investigator whether or not he would have counted himself blest by fortune if he could have stood where his successor stands to-day. I may remark parenthetically, that this imaginary operation can be performed with considerable assurance, using much shorter intervals of time and more restricted areas of interest. By so doing one can give meaning to the word progress as applied to intellectual undertakings.

We would do well, therefore, to merge portions of Bacon's two classes (his first and third), history and philosophy, into one which we may designate "accumulative knowledge." In this area we can speak of the advancement of learning and indeed apply such tests as I have suggested to see whether or not learning has advanced over the course of the last few generations. We can even estimate the chances of further rapid progress on a given restricted front. And such estimates are of profound significance in regard to this question of the relevance of scholarly activities. For in a free democratic society dedicated to the preservation of the dignity of the individual, I believe a true advance in learning will always be considered relevant. Quite apart from any idea of utility (however we stretch the word), I am convinced that intelli-

gent men and women in the sort of America I have dared envisage for the 1960's will be ready to cheer each new step forward; they will be ready to acclaim the acquisition of new territory by the "empires of the mind."

But let us be quite certain that we do not mistake the mere acquisition of information for an advance in knowledge. For the piling up of new facts may or may not be relevant to future intellectual progress or to society's needs. All who are familiar with the history of the physical sciences know that there has been a tremendous amount of thrashing around in the underbrush even during those times when giants were hewing out dazzling paths through the virgin forests. Or to vary the metaphor, we are all aware of how many scholars have continued to dig assiduously but unprofitably in exhausted mines. All of which is inevitable and trivial except when loyalties and traditions urge men to claim either that digging is a worthwhile activity in and for itself, or that the yield from an exhausted vein is full of gold.

It is at this point that the argument between "science for science's sake" and social utility begins. It may soon degenerate into an argument for the continuation of a particular line of intellectual activity merely because this has once been a fruitful direction of adventure. The argument soon becomes an emotional defense by those who love the field in question and who endeavor to support their loyalty by an appeal to general principles of the sacredness of all knowledge. At this point young scholars start leaving the academic halls. Society becomes impatient. And rightly so.

IV

Let me now turn from the first category—accumulative knowledge—to the other two which, following Bacon closely, I shall designate as poesy or, if you prefer, poetry and philosophy. Whereas the idea of progress is both valid and significant in the first category, accumulative knowledge, in the other two the concept is not only invalid but a positive deterrent to relevant undertakings. And at this point, lest all but scientists, mathematicians and archeologists leave the room in protest, I hasten to assert that I place no halo over the word progress. There is no hierarchy implied in my classification.

Indeed, any one who wished to give poetry or philosophy an inferior place as compared to accumulative knowledge would soon find himself in an untenable position. For it is obvious that poesy or poetry on the one hand and philosophy on the other together hold the keys to man's immediate future, including the future of the advance of accumulative knowledge. That this is so, current history provides ample proof. Nazism triumphed in Germany not because the Germans were lacking in power to advance learning but because bad poetry and a wrong philosophy prevailed. Remember that unless we are to have a free society there will be little chance for progress in understanding the world of animate and inanimate nature in which we live. And yet this progress or the lack of it will affect only slightly the freedom or the lack of it in the United States in the postwar years. On the other hand, the ideals, the hopes, the ambitions as well as the doubts, the anxieties, and the fears of millions of men and women may well prove decisive. And these thoughts and emotions are largely conditioned by the poetry and philosophy of the day.

There are countless vexatious questions which must be daily answered by each of us as individuals and collectively as a nation, and for which there are as yet no answers provided by our fund of accumulative knowledge. Considerable nonsense is often talked about applying the scientific method to social problems. What is this scientific method? The usual philosophic inquiries into the question seem to me a bit unreal when one surveys the range of methods actually employed by sciences as remote from each other as geology, systematic botany, organic chemistry and mathematical physics. Perhaps science is after all only organized common sense, preferably derived from experiment and preferably organized on a quantitative basis.

Perhaps by the scientific method one means only an impartial examination of a situation, an honest attempt to use rational powers to analyze complexities. If so, the phrase is badly chosen. It blinds us to an important distinction between situations where value judgments are by necessity involved and those where they can be eliminated from the frame of reference. Only in the latter case are methods comparable to those used in the advancement of knowledge really applicable. Yet the difference between disciplined and well-informed judgments involving values on the one hand, and on the other extravagant and ignorant opinions, is the difference between civilization and barbarism.

One of the chief ends of education is surely to develop the capacity for making civilized judgments on all those matters of value which are involved in so many vital human decisions. Such judgments can be illumined often by our knowledge of the past experiences of the race, but they are largely determined by emotional reactions and channels of thought whose pattern by necessity varies from age to age. It is thus the poetry and philosophy of the present, rather than accumulative knowledge, which play the significant role in outlining the next act in the drama of world history.

If we use the term poetry to cover all creative insights into human destiny whatever their form may be, and the word philosophy to include the whole expanse of analytical and speculative thought except for mathematics and the sciences, we see that many aspects of a scholar's labors fall within these bounds. Together with accumulative knowledge these two classes comprise the field of secular learning. All matters closely related to religious faith must form a fourth category. With their relation to society and the scholar, I do not propose to deal to-night. For, in the phraseology of Bacon, I am not trespassing on the field of divine learning, but confining myself entirely to that of human learning.

With this limitation, all the usual fields of scholarly activity are included in the three categories I have named: accumulative knowledge, poetry and philosophy. Many cut across two and even all three. For example, history as an interpretation by the present of the past must rest on accumulative knowledge, but consciously or unconsciously reflect the philosophy of the writer; and it has been said more than once that every great historian is not only a historian but a poet. In general, the humanities and the social sciences, to use our modern terms, cut across all three fields, and only rarely does the major part of a traditional subject fall within the boundaries of accumulative knowledge. For this reason it would seem a grave error to treat these disciplines as though the increase of accumulative knowledge (an advance in learning) were the significant aspect of the undertaking. Only in a very few instances is that true to-day, in my opinion.

The significance of poetry and philosophy is not to be measured in terms of progress or advance. Try, for example, my imaginary operation of bringing back to life great figures of the past. We can hardly doubt how Galileo, Newton, Harvey or Winckelmann would respond to a glimpse at the contemporary answers to the questions which they raised. It is far otherwise with Michelangelo, Rembrandt, Dante, Milton or Keats. It is far otherwise with Thomas Aquinas, Spinoza, Locke or Kant. You and I might argue until midnight whether or not the particular artist or poet or philosopher would feel that the present state of art or poetry or philosophy was an advance or a retrogression from the days when he himself was a creative spirit. There would be no unanimity among such an audience as the one I am addressing to-night; and more significant still, no agreement between the majority view which might prevail here and that which would have prevailed in a similar gathering half a century ago.

We are not dealing with accumulative knowledge when we speak of poetry or philosophy. We are dealing with something far more vital, in a sense far more practical; something that affects for better or worse the ambitions and the conduct of civilized man. The advance of learning is here a trivial matter; relevance is tested by the ordeal of battle. New disciples will flock to those masters who sit not in an ivory tower or with their vision fixed on a by-gone day, but who endeavor to understand and interpret the scene that unfolds year by year before their eyes; or to those others who, alive to the significance of the present, seek to bring nourishment and enlightenment from the wisdom of the past.

It has been well said that a poet's garden should be not in the market place but hard by. By the same token, a university—the home of scholars—should be bounded by both the market place and the poet's garden. This location presupposes, of course, that there will be ample opportunity for communication over the academic walls. The philosophers and those who seek to advance learning, I assume are largely academicians. How much they should also be either poets or active in the market place is an open question. As far as the accumulation of knowledge is concerned, the problems involved are rather superficial. The relation between pure and applied science can be adjusted with little difficulty and to the mutual advantage of both the progress of science and the welfare of society.

The same is true of those aspects of social science which are clearly concerned with accumulative knowledge. But when we come to the more usual case, where large elements of philosophy and some poetry are admixed, the situation alters. Since the relevance of such undertakings depends on their relevance to the ideals of the future which arise from the maelstrom of the present, one can maintain that the social philosopher must travel constantly between the market place or forum and the academic halls.

On the other hand, a well-known economist has expressed the view that

> the service of social science and the practice of the arts of democratic government are vocations each of which may be pursued with sincerity and singleness of purpose, but they cannot be combined. A social scientist cannot become a politician by speech or writing or affiliation without losing value as a scientific investigator and a teacher. Without derogation from essential academic freedom, those who choose the academic vocation in the social sciences should impose on themselves reticences and self-denials in the political and practical field, which would not be necessary for teachers of other subjects, but are necessary to give to the social scientist that emotional detachment from his subject which comes naturally to the biologist or chemist.

It may be a surprise to many to learn that the as-

thor of these words is Sir William Beveridge. The quotation is from his farewell address to the London School of Economics in June, 1937. The sentiments expressed are directly contrary to what is current practise both here and in Great Britain. Which view is right?

I wonder if the answer is not to be found in the distinction I have endeavored to maintain between accumulative knowledge and philosophy. If we call those whose aim it is to advance learning scientists (though this is bad nomenclature), then if a professor wishes to be a social scientist he may well follow Beveridge's admonition. If, however, he is a social philosopher and wishes his thinking to be germane to the problems of the day, he can hardly fail to become identified with politics from time to time—that is, he will take a position that results in his being affiliated in the public eye with an issue which has become political. In a sense he is an applied scholar and his political activity is as much a measure of his stature as the corresponding field activities of an applied scientist or engineer.

The difficulties seem to me to arise primarily because confusion reigns over what is social science and what social philosophy. Or, perhaps, more often the confusion arises because a given professor endeavors to be at the same time a social philosopher and a social scientist. I think the academic world needs both; but I doubt if they can be combined in a single individual for the reasons Sir William Beveridge has pointed out. Furthermore, I think the distinction between the two types of individuals might well be made explicit with advantage to both the public and the universities.

I have assumed that a major share of both advancing learning and fostering philosophy will be the responsibility of the universities in the years ahead. Research institutes will, of course, also play an important part, particularly in the applied sciences including medicine. But by and large the more fundamental the scholarly or scientific work, the more difficult it is to provide for it in advance. The exceptional man turns the unexpected corner in ways which can not be foreseen. No one can designate the targets in advance. This fact makes difficult the organization of research even in applied fields. It practically makes impossible the planning of research in other areas. The scholar must be a free agent and may or may not be productive. This being the case, it is unlikely that society will foot his bills: hence a larger share of scholarly undertakings must be coupled with another activity, namely, professional teaching. And the organization of our universities must be kept as flexible as possible if they are to serve the nation as they should. Whenever we are fortunate enough to see a man of genius emerging, he should be given the greatest possible scope within a university. The usual academic compartments should not confine him either in his relation to the students or to the investigation which he has in mind.

Our scholars will be teachers. I except only the fields of applied science, including medicine. I base this prophecy on the past history of the methods by which society has supported the advancement of learning even in times of unqualified enthusiasm. But whether or not the combination of professional education with scholarly endeavors is the most likely way of financing the latter, is it not essential that our intellectual leaders be in close contact with the most promising youths of the uncoming generation? There is no other way in which we can be certain that the current of intellectual adventure will continue to flow vigorously ahead.

In the United States we have many different types of institutions of higher learning. This is fortunate for several reasons. In the first place, we can rest assured that only drastic action could enforce a regimentation. In the second place, the number and variety of our universities spell assurance that there will be intensive competition. This in turn means we shall continue to provide adequately by one means or another for exceptional scholars and brilliant teachers. These two advantages are great, indeed, and far outweigh the evils inherent in the inchoate educational system which to outsiders seems often both inexplicable and thoroughly unsound.

The great flame of war which has seared all of Europe places heavy responsibilities in our hands. A large share of the future of the scholarly activities of the world must be carried on in the next decade on this continent. To meet this challenge we need invoke no powers of the Federal government, nor embark on a vast program of building special institutes for scholarly undertakings. We need not organize into a hierarchy our institutions of higher education. We need only make certain that to foster the spirit of free inquiry shall be an ambition of the American people. We need ask only that the nation support our diversified American universities, not only as educational institutions but as communities of scholars. If the response be favorable, for the rest we need have no fear.

V

Now in conclusion, may I say just a word in answer to the obvious criticism that in trisecting the field of intellectual activity in a new and arbitrary fashion I have destroyed the unity of the ancient society of scholars. To my mind, the unity of the world of pure learning (including science, philosophy and

as much of poetry as the writers, artists and poets will allow) is based not on a common method but on a common motivation. Perhaps, I should rather say dedication. For the scholar, the seeker after truth, whether he be mathematician, archeologist, scientist, philosopher, poet or theologian, must come into the court of public opinion not only with clean hands but with a consecrated heart. He must have integrity of purpose, a disciplined imagination and the power of critical analysis both of the problem at hand and his own contributions. In addition he must have high standards of performance as to the technical aspects of his task.

His rewards are not measured in terms of material riches or the satisfactions which to many men are most enduring. For him neither wealth, nor power; neither the happiness which comes from contributing immediately to the public welfare, nor the exhilaration of being one of the builders of an expanding industrial age. Unlike the applied scientist or the social philosopher who is in the arena of active life, he will know little of the extremely unscientific problems involved in the management of men. His ambition as a scholar, a philosopher, or a poet will be merely to seek the truth with all the skill and power at his command. This he will do humbly and yet with joy and pride. For without exalting his calling above that of others, he may nevertheless hope that from his labors will issue something that the "world may not willingly let die."

OBITUARY

RECENT DEATHS

DR. ARTHUR J. TIEJE, professor of geology at the University of Southern California, died on January 25 at the age of fifty-two years.

DR. CHARLES HASKINS TOWNSEND, from 1902 to 1937 director of the New York Aquarium, died on January 28 in his eighty-fifth year.

FREDERIC WILLIAM TAYLOR, of Los Angeles, the agriculturist, died on January 12 in his eighty-fourth year.

SIR JOHN BRETLAND FARMER, botanist, a former director of the biological laboratories at the Imperial College of Science and Technology, London, died on January 26 at the age of seventy-eight years.

A CORRESPONDENT writes: "A 1943 issue of the *Bulletin of the Academy of Sciences U.S.S.R.* (Department of Technical Sciences) recently received in this country carries an obituary of Professor Sergei Alekseevich Chaplygin, member of the Academy of Sciences, who died at the end of 1942 at the age of seventy-three. Professor Chaplygin, has been the head of the Research Institute of Aviation since 1921. He is credited with important research in theoretical mechanics and aerodynamics, beginning with the development of formulas for calculation of forces acting on airplane wings in 1910. He was decorated several times by the Soviet Government. His collected works were published by the Academy of Sciences in 1933–1935, and a second complete edition has been ordered by the Soviet Government and is in preparation at the present time."

SCIENTIFIC EVENTS

THE DELHI MEETING OF THE ROYAL SOCIETY

FOR the first time since its formation in 1662 the Royal Society on January 3 held a meeting outside England. This opportunity arose, according to *The Times*, London, from the presence in India of Professor A. V. Hill, who, acting for the occasion as vice-president, convened a short session of the Royal Society, before the opening of the Indian Science Congress by the Viceroy, Lord Wavell, at the University of Delhi. *The Times* writes:

Professor Hill explained that before leaving London he had been asked by the president and council of the society to convey by this means their greetings and good will to the scientific men and women of India, and he pointed out that, although most of those present were for the moment guests, there were a few fellows among them, and the King, patron of the Royal Society, was directly represented by the Viceroy.

As already reported Professor Hill's visit to India is closely connected with the scientific aspects of the war effort. He read to the assembled Indian scientists messages of greeting from the Prime Minister and General Smuts, and from British scientific bodies, and after his address two Indian fellows of the Royal Society, Dr. H. J. Babha and Sir Shanti Bhatnagar, who have not had the opportunity of being formally admitted, signed the traditional obligation on a sheet of parchment which will be inserted in the society's charter book. Lord Wavell then declared the Indian Science Congress open.

Professor Hill read the following message from Mr. Churchill: "It is the great tragedy of our time that the fruits of science should, by monstrous perversion, have been turned on so vast a scale to evil ends. But that is no fault of science. Science has given to this generation

the means of unlimited disaster or of unlimited progress. There will remain the greater task of directing knowledge lastingly towards the purposes of peace and human good. In this task the scientists of the world, united by the bond of a single purpose, which overrides all bounds of race and language, can play a leading and inspiring part."

THE NATIONAL RESEARCH COUNCIL OF CANADA

According to an official release of the Canadian National Research Council, scientific research in Canada probably reached the peak of its contributions to the Armed Services in 1943. Based on the solid foundations built up with care in the two decades between 1918 and 1939, research activities in the Dominion were directed at once on the outbreak of the present war to the solution of many novel scientific problems arising from the new methods of warfare—mechanization on the ground, new types and tactics in aviation, advances in antisubmarine devices and operation. Now, in the fifth year of the war, Canada has an enviable record of accomplishment in the application of science to war needs.

The National Research Council is serving as the central coordinating body directing scientific research in Canada. Research in its own laboratories and in the universities and industry is a combined effort at present being directed to the solution of new and urgent problems arising out of the war. The council has been appointed the official research station of the Navy, Army and Air Force in Canada. Close cooperation between service personnel and research staff has been a large factor in the successful application of science to the solution of military problems.

Work is planned along two main lines; the conduct of fundamental and applied research, including essential test work in the National Research Laboratories in Ottawa, and the promotion, coordination and support of research in other centers throughout the Dominion by grants-in-aid, award of scholarships and the direction of research investigations under the guidance of committees of specialists appointed by the council. Effective liaison is maintained with scientific work going on in Great Britain, Canada, the other Dominions and the United States through the exchange of publications and the interchange of research workers.

Scientific problems referred to the council in connection with the activities of the Armed Forces are studied jointly by officers from Defence Headquarters and civilian personnel on the council staff. Decisions can thus be taken promptly and work started without delay. Many of the problems relate to the supply of materials and the preparation of specifications.

Much of the work of the council is carried on through committees. There are now some forty active committees working under its auspices. Important developments of special interest, because of their contributions to the health and well-being of both civilians and members of the fighting forces, are the committees on medical research. The original purpose of the Associate Committee on Medical Research is to coordinate medical research in Canadian institutions and to assist in its development. The work of this committee is now wholly directed to war problems. Three Service Committees have been established: First, Aviation Medical Research; then Naval Medical Research, and last year, Army Medical Research. The closest cooperation is maintained in all fields. Another important war-time committee of the council has directed and coordinated research in Canadian universities on sixty projects dealing with problems on the production of explosives now in use, and the development of new explosives.

Continuing its established practice the council has provided assistance to postgraduate research students in science and has made grants-in-aid of research for special investigations in the universities.

FUNGUS INFECTIONS

The following announcement has been sent to the heads of departments of tropical medicine in the medical schools of the United States and Canada:

> The group of workers studying fungus infections at Duke University has received a grant from the American Foundation of Tropical Medicine for the purpose of acting as a diagnostic and registry center for the fungus diseases of man.
>
> The service may be outlined as follows:
>
> (1) Identification of fungi already isolated from patients suspected of having fungus disease.
>
> (2) Pathologic study and registry of biopsy and autopsy materials from patients suspected of having fungus infection. (This is not to conflict with the diagnostic and registry services maintained by the several branches of the armed forces.)
>
> (3) A complete set of cultures of pathogenic fungi will be sent on request to any medical school for use in teaching courses in tropical medicine. To guarantee arrival of the fungi in proper state for study, it is necessary that requests for this material be sent at least one month prior to the time that the cultures will be necessary for demonstration.
>
> By special arrangement: (a) Serologic tests will be made in certain of the fungus infections; (b) vaccines for skin testing and therapeutic use in certain of the fungus infections will be sent upon request.

Specimens for pathologic study should be sent to Dr. Roger D. Baker, Duke Hospital, Durham, N. C. All other requests will be handled through the office of Dr. D. T. Smith at the same address.

THE STEVENS RESEARCH FOUNDATION

Organization of the Stevens Research Foundation, a non-profit corporation for scientific and industrial

research and related educational purposes, was announced on January 21 by Dr. Harvey N. Davis, president of the Stevens Institute of Technology, at the forty-first annual dinner of the Alumni Association. The foundation, which will carry on its work in cooperation with the college, aims to help to meet the new demands of the reconstruction era, including new products, new uses for old products and new and improved manufacturing processes.

In a statement made by Dr. Davis, he said:

> The research activities of Stevens have grown to such proportions that they merit an administrative set-up separate from that of the undergraduate college. All our present special research laboratories will be conducted by the new foundation. Close relationships will be maintained between the college and the foundation and their faculty and staffs—between the teaching and investigative functions.

He said that the first concrete projects to be undertaken will include powder metallurgy, towing tank and sound research, all already existing or in process of planning.

Dr. Davis, who is director of the Office of Production Research and Development of the War Production Board and who recently returned from a war mission to England, has been elected president of the trustees of the foundation.

The other trustees are Dr. Robert Crooks Stanley, president of the International Nickel Company of Canada, Ltd., and chairman of the board of trustees of Stevens Institute; Robert Cox Post, president of Post and McCord, Inc., and chairman of the executive committee of the trustees of the college; Willis Horr Taylor, Jr., member of the law firm of Pennie, Davis, Marvin and Edmonds; Charles Engelhard, president of Baker and Company, Inc.; George L. Morrison, president of the General Baking Company of New York, and James Creese, vice-president of Stevens Institute. All are trustees of the college. Mr. Post will serve as vice-president of the foundation, Mr. Taylor as secretary and Mr. Creese as treasurer.

THE WASHINGTON ACADEMY OF SCIENCES

Officers of the Washington Academy of Sciences for 1944 have been elected as follows:

President, Clement L. Garner.

Secretary, F. G. Brickwedde.

Treasurer, Howard S. Rappleye.

Vice-presidents representing the affiliated societies:

Philosophical Society of Washington, Harold F. Stimson.

Anthropological Society of Washington, T. Dale Stewart.

Biological Society of Washington, Harry B. Humphrey.

Chemical Society of Washington, Edgar R. Smith.

Entomological Society of Washington, Austin H. Clark.

National Geographic Society, Alexander Wetmore.

Geological Society of Washington, Herbert Insley.

Medical Society of the District of Columbia, Fred O. Coe.

Columbia Historical Society, Gilbert H. Grosvenor.

Botanical Society of Washington, L. Edwin Yocum.

Washington Section of the Society of American Foresters, William A. Dayton.

Washington Society of Engineers, Frank B. Scheetz.

Washington Section of the American Institute of Electrical Engineers, Francis B. Silsbee.

Washington Section of the American Society of Mechanical Engineers, Walter Ramberg.

Helminthological Society of Washington, Emmett W. Price.

Washington Branch of the Society of American Bacteriologists, Ralph P. Tittsler.

Washington Post of the Society of American Military Engineers, William N. Corse.

Washington Section of the Institute of Radio Engineers, Herbert G. Dorsey.

Washington Section of the American Society of Civil Engineers, Owen B. French.

Elected members of the Board of Managers for a term of three years, Henry G. Avers and Francis M. Defandorf.

Elected member of the Board of Managers for a term of one year, William A. Dayton.

THE BOTANICAL SOCIETY OF AMERICA

At a business meeting of the Botanical Society of America, Inc., held at the New York Botanical Garden on January 8, new officers were elected and general business transacted. The newly elected president is Dr. Gilbert M. Smith, of Stanford University. Dr. Paul Weatherwax, of Indiana University, was elected vice-president, and the new treasurer is Dr. George S. Avery, of Connecticut College. Dr. Edmund W. Sinnott, of Yale University, was elected to the editorial board of the *American Journal of Botany,* Dr. A. J. Eames, of Cornell University, is the new representative to the National Research Council, and Dr. E. J. Kraus, of the University of Chicago, is alternate representative.

The question of annual meetings during wartime was discussed, and it was voted that if sections F and G of the American Association for the Advancement of Science should organize national meetings, the Botanical Society of America would cooperate by participation in these meetings. It was further voted that if national meetings are not held for the duration of the war, then the society favors the organization of regional meetings for botanists, and recommends that such meetings shall be held when not in conflict with instructions from the Office of Defense Transportation.

SCIENTIFIC NOTES AND NEWS

Dr. Robert A. Cooke was presented with a gold medal for "outstanding contributions to clinical allergy" at the sixth annual forum on allergy which was held at St. Louis on January 22 and 23. He delivered the fourth annual forum lecture entitled "Observations on Allergic Reaction."

The General William E. Mitchell Memorial Award for 1943, sponsored by the *Aero Digest*, has been made to Igor I. Sikorsky, for "making the outstanding individual contribution to aviation progress" during the year 1943 in his development of the helicopter.

The American Society of Heating and Ventilating Engineers presented at the fiftieth annual meeting of the society the F. Paul Anderson Medal to Lieutenant Commander F. C. Houghton, USNR, at a dinner on February 2 at the Hotel Pennsylvania, New York City. The award is in recognition of "outstanding research in heating, ventilating and air conditioning."

Dr. John Alexander, professor of surgery at the University of Michigan, an authority on thoracic surgery, has been awarded the Henry Russel Lectureship. This award is given annually to the university faculty member adjudged by the Research Club of the university to have gained highest distinction in the field of scholarship. Dr. Alexander is the first faculty member to receive both the lectureship and the Henry Russel Award, the latter being given annually to a promising instructor or assistant professor. He was a recipient of the award in 1930, ten years after becoming instructor in surgery at the university.

The officers elected for 1944 by the Union of American Biological Societies are: *President*, Dr. E. G. Butler, Princeton University; *Secretary*, Dr. F. A. Brown, Jr., Northwestern University; *Treasurer*, Dr. D. H. Wenrich, University of Pennsylvania. *Executive Committee:* Dr. A. P. Hitchens, University of Pennsylvania; Dr. J. F. Griggs, National Research Council, Washington, D. C.; Dr. M. Demerec, Carnegie Institution, Cold Spring Harbor.

Dr. Morris A. Stewart, associate professor of entomology at the University of California at Berkeley, has been elected president of the Pacific Coast Entomological Society.

Dr. H. W. Rickett, of the New York Botanical Garden, who returned on November 1 from a four months' visit to Mexico, has been elected an honorary member of the Sociedad Botanica de Mexico, of which Professor Maximino Martinez, of the Instituto Politécnico in Mexico City, is president.

Dr. Harlow Shapley, director of the Harvard College Observatory, has been elected a member of the board of trustees of the Kosciuszko Foundation of New York City. During the coming months the foundation will formulate plans to aid in the educational reconstruction of post-war Poland and in Polish-American relationship.

At a meeting of the Council of the Royal Agricultural Society of England on December 15, Sir George Courthope, M.P., was elected president for 1944 in succession to Lord Mildmay of Flete, who has held office since 1941. The council decided to approach other agricultural bodies that had prepared reports on post-war policy with a view to common action in pressing the government for the earliest possible production of its post-war agricultural policy.

Edgar H. Boles, president of the General Reinsurance Corporation, has been elected president of the New York Post-Graduate Medical School and Hospital to succeed Dr. Arthur F. Chace. Dr. Chace, president of the New York Academy of Medicine, has served as president of the medical school and hospital for fourteen years.

Dr. George Lynn Cross, acting dean of the Graduate College of the University of Oklahoma, head of the departments of botany and bacteriology, has been named acting president of the university. He takes the place of Joseph A. Brandt, who became director of the University of Chicago Press on January 1.

Dr. Earl B. Smith, of the department of mechanical engineering of the College of the City of New York, and Dr. Alexander Marcus, of the department of physics, have been promoted to full professorships. Dr. Emil L. Post has been appointed associate professor of mathematics.

Charles Henry Schumann, of New York City, has been appointed to succeed the late William Griswold Smith as professor in engineering drawing and descriptive geometry for the Navy V-12 College Training Unit at Franklin and Marshall College, Lancaster, Pa. Since 1940 he has been head of the drafting department of the Defense Training Institute of the Engineering Colleges of Greater New York. Previously he had been head of the drafting department of Columbia University.

Dr. L. F. Thomen has been appointed Undersecretary of State for Health and Public Welfare of the Dominican Republic.

Dr. H. D. Dawson, for the past fourteen years head of the department of chemistry of Bethany College, W. Va., has resigned to accept a position with the Goodyear Rubber Company in the field of synthetic rubber. Dr. George W. Bennett, formerly head

of the department of chemistry at Washington and Jefferson College, has been made acting head of the department.

MAJOR GENERAL FOLLETT BRADLEY, U.S.A. (retired), formerly in command of the First Air Force at Mitchel Field and air inspector at the headquarters of the Army Air Forces at Washington, has been named assistant to the president of the Sperry Gyroscope Company.

ARTHUR T. PIENKOWSKY, until his retirement on January 1 physicist in charge of the testing of balances and weights at the National Bureau of Standards, Washington, D. C., has joined the staff of the Torsion Balance Company and Christian Becker, in direct charge of research and control. Mr. Pienkowsky has been associated with the bureau for forty years.

FRANK C. WONDER, assistant taxidermist of the Chicago Museum of Natural History, has leave of absence, to work on the investigations of the Illinois State Natural History Survey on the migrations of ducks on the Illinois River.

W. H. CAMP, assistant curator at the New York Botanical Garden, who has been on leave of absence for two months in Central America and a year in Haiti, has returned.

DR. FRANK K. SCHOENFELD, technical superintendent of the division of chemistry of the B. F. Goodrich Company, Akron, Ohio, has become director of the division of technical research and development.

J. MORGAN JONES, registrar of the University College of Wales, Aberystwyth, who has been closely connected with the food production campaign in Wales, has been appointed Welsh secretary of the Ministry of Agriculture in succession to Dr. C. Bryner Jones.

IT is reported in *Nature* that the British Secretary of State for the Colonies has appointed N. F. Hall, director of the National Institute for Economic and Social Research, to be development adviser for West Africa. He will be on the staff of the resident minister and will act in close consultation with the Governments of Nigeria, the Gold Coast, Sierra Leone and the Gambia, which have been working for some time on plans for post-war development. Mr. Hall has been on leave of absence from the National Institute since 1938 for war work, and has served as joint-director of the Ministry of Economic Warfare. More recently he has been in charge of economic warfare work at the British Embassy, Washington, where he held the rank of minister in the diplomatic service.

AFTER an interval of four years the Royal Institution Christmas lectures, "adapted to a juvenile auditory," have been revived. The Christmas season's course of six lectures, which opened on December 28, as reported in *The Times*, London, had been unbroken until the present war broke out. The lecturer was Dr. E. N. da C. Andrade, Quain professor of physics in the University of London, and his subject was "Vibrations and Waves."

DR. S. A. WAKSMAN, microbiologist of the New Jersey Agricultural Experiment Station, will give at Syracuse University on February 18 an address before a joint meeting of Sigma Xi and the Syracuse section of the American Chemical Society entitled "The Production and Nature of Antibiotic Substances."

DR. RAYMOND JOHN SEEGER, associate professor of physics at the George Washington University, delivered on January 15 the address of the retiring president of the Philosophical Society of Washington. His subject was "Understanding Electric Breakdown in Solids."

THE twentieth Ludvig Hektoen Lecture of the Frank Billings Foundation, under the auspices of the Institute of Medicine of Chicago, will be given on March 24 by Dr. Shields Warren, of Boston. He will speak on "The Effects of Radiation on the Human Body."

THE Distinguished Service Award has been conferred by the Ordnance Department on the Society of Automotive Engineers "in recognition of outstanding and meritorious engineering advisory services in war and peace; in design, manufacture and maintenance of ordnance matériel."

APPLICATIONS to the Committee for Research in Problems of Sex of the National Research Council for financial aid during the fiscal year beginning on July 1, in support of work on fundamental problems of sex and reproduction, should be received before April 1. They may be addressed to the chairman, Dr. Robert M. Yerkes, Yale School of Medicine, New Haven 11, Conn. Although hormonal investigations continue to command the interest and support of the committee, preference, in accordance with current policy, will ordinarily be given to proposals for the investigation of neurological, psychobiological and behavioral problems of sex and reproduction.

THE American Society for Clinical Investigation will hold its annual meeting on May 8 at the Claridge Hotel, Atlantic City, N. J. This will be the thirty-sixth annual meeting.

A CONFERENCE of the Section of Physics and Chemistry of the New York Academy of Sciences will be held at the American Museum of Natural History on

Friday, February 11, and on Saturday, February 12, on "Energy Relationships in Enzyme Reactions." In addition to members of the academy, attendance is limited to those invited to participate.

LORD DE LA WARR, chairman of the British Agricultural Research Council and director of home flax production at the Ministry of Supply, is visiting Canada to speak throughout the Dominion on the war-time agricultural effort of the United Kingdom.

A PERMANENT collection of chemical compounds isolated from the tubercle bacillus, the only such collection in existence, was presented to Yale University by the National Tuberculosis Association on February 3. The collection, which is the result of seventeen years of research by Professor R. J. Anderson, of Yale, and his associates, will be presented by Dr. Lewis J. Moorman, president of the National Tuberculosis Association, and will be received by President Charles Seymour, of the university. The ceremony will be held in the Sterling Laboratory of Chemistry. Dr. William Charles White, chairman of the Committee on Medical Research of the National Tuberculosis Association, will speak on the work of his committee, which initiated the research in 1926 and which has supported the work since that time.

THIRTEEN bound volumes of the research bulletins of the Missouri Agricultural Experiment Station, with inscription on the outside front cover, "A token of friendship to our Russian allies from the citizens of Columbia, Missouri, U. S. A.," have been received by the National Council of American-Soviet Friendship from Dr. Henry E. Dent, dean of the Graduate School of the University of Missouri. These volumes have been handed over to the Soviet Embassy in Washington which will forward them to the chief of the Agricultural Library of the Lenin Academy of Agricultural Science, Moscow.

THE University of Rochester in cooperation with the Bausch and Lomb Optical Company, is offering a new scholarship plan designed to bring "outstanding science students to the university." Five scholarships, sponsored by the company, of the value of $500 each year for a term of three years, will be made available for competition beginning this year.

A DIAGNOSTIC and guidance clinic for inebriates will be opened at Yale University this month under the joint sponsorship of the Yale Laboratory of Applied Physiology and the Connecticut Prison Association. A similar clinic will also be opened in Hartford in the near future. Dr. Ralph Banay, psychiatric consultant of the New York State Parole Board, formerly chief psychiatrist of Sing-Sing Prison, will be the medical director and will supervise both the New Haven and Hartford clinics, with Dr. Clements C. Fry, psychiatrist, of the department of health of Yale University, as adviser. Dr. Banay will also participate in the routine clinical work. Dr. Anna Roe will be in charge of psychological testing, and Raymond G. McCarthy of social work. Dr. Howard W. Haggard, director of the Laboratory of Applied Physiology at the university, will have general charge of the clinic program.

DISCUSSION

AMORPHA FRUTICOSA CONTAINS NO ROTENONE

ROTENONE and related insecticidal compounds have been reported to occur in more than 70 species of plants,[1,2] all of which are members of the family Leguminosae. In some cases rotenone or one of the rotenoids[3] has been isolated and characterized. In others a color test has been applied which has been taken as indicating the presence of this group of compounds. The test most frequently used is that of Durham.[4] The Gross-Smith test as modified by Goodhue[5] and the Rogers-Calamari test[6] also have been applied. Until recently these tests have been accepted as specific for rotenone and the rotenoids, especially when applied to leguminous plants. In 1942 Harper[7] showed that some synthetic furanoisoflavones also give a positive Durham test. These compounds, prepared from some of the rotenone derivatives, are insecticidally inert.

In 1937 Moore[8] concluded that rotenone was present in the roots, stem bark and seed of *Amorpha fruticosa* from Nebraska, because they gave a positive Durham test. In 1942 Featherly,[9] of the Oklahoma Agricultural and Mechanical College, suggested that, inasmuch as this plant is widely distributed throughout the Mississippi River Valley, its seed might serve as a source of rotenone during the war emergency. At his request seed from widely different locations were examined in the Bureau of Entomology and Plant Quar-

[1] H. A. Jones, *U. S. Bur. Ent. and Plant Quar.*, E-571, 14 pp., 1942. [Processed.]

[2] R. C. Roark, *Jour. Econ. Ent.*, 26: 587, 1933.

[3] R. C. Roark, *Jour. Econ. Ent.*, 33: 416, 1940.

[4] H. A. Jones and C. M. Smith, *Ind. Eng. Chem., Anal. Ed.*, 5: 75, 1933.

[5] L. D. Goodhue, *Jour. Assoc. Off. Agr. Chem.*, 19: 118, 1936.

[6] H. D. Rogers and J. A. Calamari, *Ind. Eng. Chem., Anal. Ed.*, 8: 135, 1936.

[7] S. H. Harper, *Jour. Chem. Soc.*, 1942, 595.

[8] R. H. Moore, *Puerto Rico Agr. Expt. Sta. Rept.*, 1937, 115 pp.

[9] *Agricultural Insecticide and Fungicide Assoc. Bul.* No. D-23, 2 pp., Oct. 7, 1942.

antine for their supposed rotenone content. Although all the samples gave a positive Durham test and Gross-Smith-Goodhue (G-S-G) test, no rotenone or any of the rotenoids could be isolated from any of them.

However, fractionation of the chloroform extractives of the seed collected at Vermillion, S. Dak., by the Soil Conservation Service yielded a compound that melted at 151–151.5° and gave a positive reaction in both the above mentioned tests. The name "amorphin" is proposed for the new compound. Analysis showed it to correspond to the formula $C_{33}H_{40}O_{16}$. The compound gave a positive orcin test but did not reduce Fehling's solution. When warmed in concentrated hydrochloric acid, the compound readily dissolved, and when further heated a product separated that after purification melted at 191–192°. Analysis showed it to correspond to the formula $C_{22}H_{22}O_7$. It also gave a positive reaction in both the Durham and the G-S-G test. The compound, tentatively designated "amorphigenin," also was obtained from the ether extractives of the seed. The acid filtrate obtained in the hydrolysis of amorphin readily reduced Fehling's solution.

It thus appears that *Amorpha fruticosa* contains a glycoside which, as well as its aglycone, behaves similarly to rotenone in certain color tests. Details of the experimental procedure will be published elsewhere.

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POST-WAR PLANNING IN RUSSIA

ISSUE No. 20 of the *Astronomical Circulars* published by the Bureau of Astronomical Information of the Academy of Sciences of the U.S.S.R., dated August 13, 1943, contains an interesting plan by D. J. Martinov for the construction of a large southern astrophysical observatory. This plan was apparently presented at a conference of astronomers last September, together with reports by G. A. Shajn and I. A. Dukov on the development of astrophysics and positional astronomy in the U.S.S.R. The destruction of the Pulkovo Observatory has made it necessary to reconsider former plans, and it is now suggested that Pulkovo be reestablished as a center of positional work, together with the Engelhardt Observatory near Kasan, the Nikolaeff Observatory and the Tashkent Observatory. Astrophysical work, on the other hand, is to be largely transferred to a new powerful observatory for which the city of Simferopol in the Crimea has been suggested. This institution is to consist of a central office in or near Simferopol, and of three observing stations—a mountain station at an elevation of about 2,000 meters (presumably in the mountains south of Simferopol); a high-altitude station for solar research at 3,500 meters, and a southern station, possibly in Africa. The equipment is to consist of two 80-inch reflectors (at Simferopol and in Africa), one 120-inch reflector (at the mountain station), two 16-inch double astrographs, one 50-inch and one 30-inch Schmidt telescopes, solar towers similar to those of Mount Wilson, a nebular spectrograph, a coronagraph of the type of Lyot, two 30-inch refracting telescopes (the author says "two reconstructed Pulkovo refractors . . ." which suggests that these instruments were saved), and numerous accessory instruments.

The author recommends that many of these instruments be ordered abroad because

> there are foreign firms which have established reputations in this field and to duplicate their experience and skill at home would take too much time; the construction of such giant instruments as the 120-inch and 80-inch reflectors in this country (the U.S.S.R.) would take many years, while the firm of Warner and Swasey would undoubtedly carry out such a project rapidly and skilfully. Similarly, in the construction of measuring instruments there is no need to compete with the Gaertner Scientific Corporation, or in the construction of accurate clocks with the Shortt concern.

The staff of the new observatory is to consist of 60 to 70 trained astronomers. Since there are not now enough persons available with the required astrophysical experience, it is suggested that the existing universities in the U.S.S.R. at once begin the training of some 60 to 70 students in each organization. The plan provides for the completion of the equipment and the staffing of the observatory in about 1947. For the purpose of facilitating the training of the necessary staff, the author recommends that orders be placed at once abroad for the purchase of various instruments at a cost of two or three million rubles.

The breath-taking scope of this plan will probably startle those who have had little inclination during the past two years to indulge in post-war planning. It shows an extraordinary spirit among the scientific workers of the U.S.S.R., especially if we consider that the plan was prepared at a time when even the proposed site of the new observatory was still in the hands of the enemy. Perhaps it would be advantageous to the organizers of the astrophysical observatory in Russia if they would augment their plan by sending to the United States and to Great Britain a few of their best astrophysicists. These visitors could study the performance of various types of instruments and profit from the experience of existing observatories. They could also broaden the basis of their interests and secure adequate training in those

branches which have not previously been developed in Russia. Since it is generally recognized that Russian astrophysicists have obtained remarkable results in many fields of study the benefits of such an arrangement would be by no means one-sided and our own observatories would gain enormously from the contact.

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IS TEACHING ABILITY RECOGNIZED?

LIKE a refrain one hears in current discussions of academic problems remarks like the following: "These objectives can be obtained only if the teaching ability of faculty members is given as much recognition as is given to research ability." "Teaching ability is not rewarded by our colleges as is research ability."

If some one does not soon question the accuracy of these statements they will come to be believed through mere repetition. The first time I ever heard the validity of such assertions openly and adequately challenged was during the meeting of the American Society of Agronomy at St. Louis in November, 1942. A session was being held on teaching and its problems. A guest speaker had repeated the time-worn remark that in our colleges teaching is not rewarded as is research. In the course of the discussion which followed Dr. H. K. Hayes, of Minnesota, offered the comment that teaching ability in that field was recognized and rewarded. He added that if necessary he could present the proof.

The discussion went on. As I was a visitor, only a few of the men present were known to me personally. It was, however, evident from the remarks that many of them were men of unquestioned eminence in their field. The group evidently included a good number of heads of large departments of agronomy and a sprinkling of deans of agriculture. Finally some one asked Professor Hayes for his proof. His reply, which I quote from memory, was somewhat as follows: "I have objective proof. It is here in this room. I do not wish to embarass anyone so I will not name individuals unless someone insists, but I see here a goodly number of individuals of recognized standing and influence in their fields whose positions rest on their recognized ability as teachers rather than as investigators." That ended the discussion.

One result of the discussion thus ended was that I started a survey of the teaching of botany in the United States during the past generation. Some portion of the material assembled will be published elsewhere. One of the conclusions to which I have come is a wholehearted agreement with Professor Hayes's spontaneous outburst at St. Louis. It makes little difference what objective criterion of eminence one chooses provided the list contains a fair number of names. A list of presidents of the Botanical Society of America will serve or a list of the presidents of any of the other societies concerned with plant science or the chairmen of Section G, or of those who have received the now much discussed "stars" in "American Men of Science." In any case one finds a large percentage of those who are known first and foremost as teachers. This is particularly impressive when it is realized how many of our colleagues have to give all their time to research or administration.

The same thing may not be true in fields other than those of the plant sciences. At least the question may fairly be raised regarding them. Of course I have no information as to the salaries received by these outstanding teachers; that seems to be the critical point, but it seems unlikely that they have been conspicuously less well paid than their fellows.

Apparently one source of the assertion so freely made that teaching ability as such is not adequately rewarded is the failure of those who make it to recognize that teaching ability may be coupled with other abilities. In other words, the mere fact that a member of a college faculty is unable or unwilling to carry out a research program does not constitute *prima facie* evidence of teaching ability of a high order.

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SCIENTIFIC BOOKS

ERUPTIVE ROCKS

Eruptive Rocks, Their Genesis, Composition, and Classification, with a Chapter on Meteorites. By S. JAMES SHAND. Second edition. New York: John Wiley and Sons. London: Thomas Murby and Company, 1943. Pp. xvi + 444; figs. 47, pls. 3. $5.00.

THIS second edition of Professor Shand's notable book has been extensively revised. The wide field and laboratory experience of the author and his many contacts with the points of view of petrologists of three continents, as a student in Scotland and as a teacher in South Africa and America, give him an unusually comprehensive grasp of the subject. This has resulted in a book which gives the best elementary treatment of the eruptive rocks that is in print. The author has a wide familiarity with the literature and lists many references at the end of each chapter. Throughout, the discussions are brief and critical, and they preserve an excellent balance between the field,

the laboratory, and the geochemical data and arguments.

The first chapter deals with such properties of magmas as their fluidity, water content and temperatures of consolidation. For the latter he boldly places the temperature of consolidation of extrusive rocks above 700° and those of most granular rocks from 700° to 500°. These temperatures are probably lower than would be given by most petrographers. At the time the quartz of the pegmatites was studied all the pegmatites were thought to be magmatic, but our present knowledge indicates that all the low quartz tested from pegmatites was hydrothermal and all the magmatic quartz was high quartz. There is no convincing evidence that the temperature of crystallization of the extrusive rocks is much, if any, higher than that of the granular rocks with the same composition.

The second chapter deals with the minerals and mineral families in the eruptive rocks and the relative abundance of the oxides and elements. The descriptions of the mineral families deal chiefly with their chemical compositions and artificial formation. It recognizes the complexity of the rock minerals and explains this on the modern theory of atomic substitution. The descriptions are brief, but they are clear and accurate and so are suitable for an elementary student.

Chapter 3 deals with the *fugative constituents* and is a well-balanced discussion of the field, laboratory and geochemical data.

Chapter 4 discusses the temperature and pressure in the magma. The discussion is excellent. However, the reviewer has concluded both from a study of the literature and from personal observations that inver*sion of quartz to tridymite* by *magmatic* heat is very rare, and we still need clear evidence that it takes place. The data on the effect of pressure on the high-to-low-quartz inversion are accurately known. The curve of Goldschmidt on the effect of pressure on the reaction $CaCO_3 + SiO_2 \rightleftarrows CaSiO_3 + CO_2$ has little value as the pressure involved is the vapor pressure of CO_2 and this may be low since the CO_2 escapes as the reaction takes place.

Chapter 5 on the freezing of the magma presents chiefly the psysico-chemical data. Chapter 6 on the magma and its walls places reasonable emphasis on reaction and assimilation by the magma. Chapter 7 on the order of crystallization fails to give sufficient emphasis to the natural chilling experiments prepared for us by nature in the lavas and small intrusive bodies. Chapter 8 deals with compatible and uncompatible phases and Chapter 9 with eruptive rock complexes.

The next ten chapters deal with the classification and description of rocks and with problems that concern chiefly one group of rocks. After a general discussion of rock classification, the author presents his own system. The major divisions are based on the rather obvious and commonly used silica content—oversaturation, saturation, or undersaturation. The next subdivision is based on the alumina content with respect to that required to form feldspars and feldspathoids. Does a broad study of rocks justify such great importance being given to alumina? Next are four divisions depending on the proportion of dark minerals. Then four divisions based on the proportion of the different feldspars or feldspathiods: or $>$ an and or $>$ ab; or $>$ an and or $<$ ab; or $<$ an and ab $>$ an; and or $<$ an and ab $<$ an.

Shand's system of classification seems to differ materially in many respects from that in common use, yet rock names are used by Shand with much the same meaning as in other systems.

Shand's book is very well written. It does not present the material dogmatically but gives the arguments pro and con clearly and concisely. The reader is shown the complexities and uncertainties that are inherent in nearly all petrological problems.

The repeated use of the terms acid and basic rather than silicic or some other more appropriate terms and the use of alkaline for alkalic will be unwelcome to many American petrographers who have been attempting to discourage the use of these inappropriate terms.

The philosophical quotations at the beginning of each chapter are apt.

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CHEMISTRY

Chemistry Made Easy. By CORNELIA T. SNELL and FOSTER DEE SNELL. D. Van Nostrand Company, Inc., New York. 1943. 4 vols $7.95.

IN four small volumes this collection runs the gamut of introductory chemistry: theoretical inorganic (184 pp.), descriptive inorganic (232 pp.), organic (256 pp.) and industrial chemicals (542 pp.).

As for the first two volumes, the part-time scientist may prefer their easy style to the pedantry of most general chemistry text-books, and certainly will welcome the interesting bits of industrial information which reflect the authors' close association with chemical industry. Unfortunately, theory is sketchy and occasionally incorrect; and a sound perspective of the family relationships of the elements is lacking. For example, the cart seems before the horse in the statement (II, 12) that H_2F_2 is written as a dimer because it forms acid salts, rather than writing that its molecular weight so indicates; or that (I, 98) "the essential characteristic of an element (in forming com-

pounds) is the number of free protons in the nucleus, rather than the number of planetary electrons." The chapters on radioctivity and colloids are brief and inadequate. Polonium, not radium (II, 206), was "the first radioactive element to be discovered"; and the Great Bear Lake deposits, rather than Colorado carnotite, deserve mention. Also, in attempting to make chemistry easy the authors have omitted such difficult but important topics as chemical equilibrium, energy in chemical reactions, determination of atomic and molectular weights and a thorough treatment of ionization. There are three chapters on pH, including colorimetric and electrometric methods for determining pH; nevertheless their excellent treatment justifies the inordinate space, one tenth of Volume I, allocated to it. To lower costs, pictures and portraits are omitted.

The concluding two volumes are vastly better. The beginner will find Volume III an unusually good brief on aliphatic and aromatic compounds, and I can recommend it enthusiastically. The descriptive matter is carefully organized and intelligently presented. Volume IV is a reprinting of "Chemicals of Commerce," the valuable reference book which has already reserved a niche for itself on the shelves of important chemical literature.

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SPECIAL ARTICLES

A NOTE ON ASCORBIC ACID: NITROGEN RELATIONSHIPS IN GRAPEFRUIT

PHYSIOLOGICAL studies of the yield, quality and maturity of Marsh grapefruit in Arizona carried on by the Department of Horticulture of the Arizona Agricultural Experiment Station[1] have revealed certain influences of seasonal nitrogen supply. Grapefruit from trees having a high nitrogen nutrition throughout the year, as determined by foliar analyses, have been found to be less sweet, to color later, be thicker-skinned, poorer-shaped and to be of lower market grade than fruit from trees having a declining nitrogen content through the period of fruit growth and maturity.

Since the importance of grapefruit lies chiefly in its nutritive value, especially its vitamin C content, it seemed desirable to investigate the relationship of the ascorbic acid content of the fruit to the nitrogen nutrition of the tree.

Accordingly, five representative fruits picked from the north, south, east, west and center of four grapefruit trees from a high nitrogen experimental plot and four grapefruit trees from a low nitrogen experimental plot at the university orchard, Yuma, Arizona, were harvested at weekly or bi-weekly intervals beginning September 28, 1942, continuing until January 31, 1943. The fruit was shipped to the Department of Human Nutrition, of the Arizona Agricultural Experiment Station in Tucson. A total of 540 of these Marsh grapefruit were analyzed separately for their volume of juice, pH, total acidity, Brix: acid ratio, and ascorbic acid content. The ascorbic acid assays were made following the method of S. A. Morell. The bleaching effect of ascorbic acid on 2–6 dichlorobenzenone indophenol was measured in the Evelyn photoelectric colorimeter, correction being made for turbidity and other interfering pigments.

Analyses were carried on in a similar fashion with Marsh grapefruit from the Phoenix, Ariz., area. Data were found to agree with those shown in Table I for Marsh grapefruit from Yuma.

TABLE I

ASCORBIC ACID CONTENT OF MARSH GRAPEFRUIT JUICE (YUMA) AS RELATED TO NITROGEN NUTRITION OF THE TREE

Date of Analysis	Low nitrogen nutrition					High nitrogen nutrition				
	Tree 3	Tree 33	Tree 4	Tree 44	Ave.	Tree 5	Tree 55	Tree 6	Tree 66	Ave.
	Ascorbic acid content mg/ml*					Ascorbic acid content mg/ml				
9/30/42	.56	.53	.59	.53	.55	.48	.46	.41	.43	.45
10/ 7/42	.50	49	.49	47	.49	.46	.43	.38	.39	.42
10/13/42	.51	.51	.50	45	.49	.42	.43	.42	.40	.42
10/21/42	.49	.47	.48	..	.48	.41	.44	.39	.35	.40
10/27/42	.48	.47	.46	.47	.47	.43	.40	.35	.33	.38
11/ 3/42	.50	.45	.50	.42	.47	.38	.41	.35	.31	.36
11/10/42	.45	.41	.50	.45	.45	.40	.38	.33	.33	.36
11/17/42	.48	.43	48	.47	.47	.37	.42	.36	.34	.37
11/24/42	.50	.46	47	.44	.47	.40	.42	.36	.34	.38
12/ 9/42	.44	43	.41	.40	.42	.38	.41	.36	.36	.38
12/20/42	.47	.43	..	..	.45	..	..	.36	.34	.35
1/ 5/43	.48	.46	..	..	.47	..	..	.34	.37	.36
1/19/43	.46	.40	.41	.38	.41	.39	.37	.35	.34	.36
2/ 2/43	.43	.42	.44	.38	.42	.36	.36	.33	.33	.35
Average	.48	.45	48	44	.47	.41	.41	.36	.35	.38

* Average of 5 fruits from each tree

It is consistently evident that the fruit from trees handled to give a low nitrogen content at harvest are higher (approximately 20 to 25 per cent.) in ascorbic acid content than those from trees in which a higher nitrogen plane prevailed. Differences of the same order were observed at each date of harvest throughout the season.

In order to gain more evidence in support of these data, studies were conducted in the present season in which both nitrogen and ascorbic acid determinations were made on grapefruit juices. These analyses were made by the Horticulture Department; ascorbic acid by visual titration with 2–6 dichlorobenzenone indophenol and nitrogen by the micro-Kjeldahl method.

[1] William E. Martin, *Univ. Ariz. Tech. Bull.*, 97, 1942.

The results of analyses of four composited samples of representative fruit from each of fifteen different trees from three experimental plots in Yuma are shown in Fig. 1.

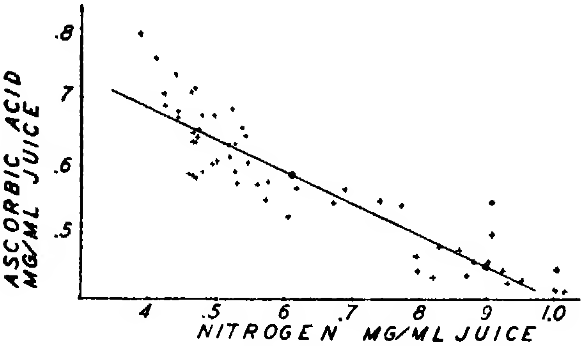

FIG. 1. Regression of ascorbic acid on nitrogen in grapefruit juice.

The data of the figure show a negative correlation coefficient of 0.91 between the nitrogen and ascorbic acid content of the juice of the grapefruit. Just why this relation between nitrogen and ascorbic acid exists in citrus juice is not clear.

As far as we are aware the high values for ascorbic acid are higher than any reported for grapefruit juice. At the same time, however, the nitrogen values are extremely low for those samples that show a high ascorbic acid content.

Perhaps it is associated with the ascorbic acid—oxidase respiratory system as described by Szent-Györgyi.[2]

It would be of interest to know if this relation between ascorbic acid and nitrogen, which has been found in Arizona grapefruit, holds for other citrus-producing areas and for other fruits or vegetables.

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THIOUREA AND RESISTANCE TO LOW ATMOSPHERIC PRESSURES ("HIGH ALTITUDES")*

IT has been reported that thyroidectomized rats are better able to tolerate exposures to anoxia and reduced atmospheric pressures[1, 2, 3] than normal animals. Administration of thyroid and injections of anterior pituitary substance have been found to increase the sensitivity of animals to oxygen lack.[1, 2, 4, 5]

Mackenzie and Mackenzie[6] and Astwood *et al.*[7] have shown recently that treatment of rats with thiourea and the sulfonamides results in the development of a state of functional hypothyroidism, characterized by an enlarged, hyperplastic thyroid gland and a drop in the B.M.R. Withdrawal of the drugs results in a return of the animal to a normal condition.[7] The administration of thiouracil to the human suffering from hyperthyroidism results in a reduction of the basal metabolic rate.[8, 9] It has been demonstrated that thiourea produces these effects by interfering with the production of normal thyroid hormone by the thyroid gland.[10]

In view of these results it became of interest to test the effects of thiourea upon the resistance of animals to low atmospheric pressures. One hundred and two adult female rats were employed in these experiments. Thirty-six of these were fed a diet containing 0.5 per cent. thiourea for periods of time varying from 4 to 30 days. Thirty others were injected with 200 mg of thiourea in distilled water 5 hours prior to initiation of the low pressure treatment. Thirty-six animals served as untreated controls. All animals were then exposed to pressures of 200 mm Hg (32,000 feet), for 2 hours in a specially constructed low pres-

TABLE 1

EFFECT OF THIOUREA ON RESISTANCE TO LOW ATMOSPHERIC PRESSURES

Days on thiourea	No. of animals	Percentage mortality	Mean thyroid weight (mg)
0 (Controls) ..	36	75	14.0
0 (Thiourea injections)	30	60	13.9
4–8	18	50	18.0
12	6	0	29.3
14	6	0	30.0
30	6	0	37.4

[2] A. V. Szent-Györgyi, "On Oxidation, etc." Williams and Wilkins Co., Baltimore, 1939.

* This investigation was supported by a grant from The Commonwealth Fund.

[1] H. Streuli, *Biochem. Ztschr.*, 86: 357, 1918.

[2] M. Duran, *Biochem. Ztschr.*, 106: 254, 1920.

[3] A. L. Barach, M. Eckman and N. Molomut, *Am. Jour. Med. Sci.*, 202: 336, 1941.

[4] B. Houssay and C. Rietti, *Compt. Rend. Soc. de Biol.*, 110: 144, 1932.

[5] J. A. Campbell, *Quart. Jour. Exp. Physiol.*, 24: 271, 1935.

[6] C. G. Mackenzie and J. B. Mackenzie, *Endocrinology*, 32: 185, 1943.

[7] E. B. Astwood, J. Sullivan, A. Bissell and R. Tyslowitz, *Endocrinology*, 32: 210, 1943.

[8] E. B. Astwood, *Jour. Am. Med. Asn.*, 122: 78, 1943.

[9] R. H. Williams and G. W. Bissell, SCIENCE, 98: 156, 1943.

[10] A. S. Keston, E. D. Goldsmith, A. S. Gordon and H. A. Charipper, *Jour. Biol. Chem.*, in press.

sure chamber.[11] At the end of this period, the mortality percentages were recorded and the thyroid glands of all animals were dissected and weighed. The results are shown in Table 1.

The data indicate that treatment with thiourea for 12 or more days enables the rats to survive a reduction of the atmospheric pressure to 200 mm of Hg, whereas the majority of the untreated controls succumb. Thiourea injections made a short time (5 hours) prior to exposure to low pressures have no apparent beneficial effect. Preliminary experiments performed with males have shown that these are also benefited by thiourea provided the treatment is applied for at least 12 to 14 days. It is to be observed that the animals on a thiourea ration for 12 or more days possess heavier thyroids than do the untreated rats or those given the drug for shorter periods of time. This enlargement of the thyroid gland, a condition which is readily reversible when thiourea is withdrawn, is indicative of the development of a hypothyroid condition.[6,7] We are of the opinion that this state of functional hypothyroidism (chemical thyroidectomy) is responsible for the increased tolerance to reduced atmospheric pressures shown by rats treated with thiourea.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A NEW METHOD FOR PRESERVATION OF HUMAN AND ANIMAL TISSUES BY THE USE OF A TRANSPARENT PLASTIC

A GOOD preservation of form of human and animal organs can be obtained by imbedding them in a transparent plastic, "Plexiglas." A method for imbedding insects and similar structures in "Plexiglas" has been proposed by Dr. Charles Sando,[1] but this procedure could not be applied successfully to fleshy animals or organs of animals and humans without considerable loss of form and color. The present process has been used so far in the case of relatively small organs (approximately $8 \times 5 \times 5$ cm) and to slices of larger organs ($10 \times 10 \times 2$ cm). There appears to be, however, no difficulty in applying the method to considerably larger objects.

The advantages of this method of tissue preservation are: (1) the remarkable preservation of size, shape and texture and the satisfactory retention of color; (2) the ease of handling of the finished specimen, which is permanent and practically unbreakable; (3) the avoidance of distortion of vision due to the curvature of the surface of containers and the preserving fluids generally employed.

Preliminary to the imbedding, it is necessary to dehydrate the tissue. This is accomplished by placing the fresh organ or piece of tissue on a layer of frozen water (5 to 10 mm in thickness) contained in a suitable receptacle, and cooled to $-20°$ C. or below, by covering the organ with cold distilled water and freezing the whole mass as rapidly as possible at a temperature of $-20°$ C. or below. The mass of ice without and within the organ is then removed by condensation of water vapor at low temperature *in vacuo*.[2] The tissues thus obtained are very light and porous and appear to have lost a great deal of the color and texture. At this point the specimen may be readily trimmed with a sharp scalpel. The dried tissues should be promptly sealed or processed so as to avoid absorption of moisture. They should be carefully brushed with a camel's hair brush, to remove any loose particles or dust and similar foreign material.

The next step in the process is the saturation of this tissue with the liquid acrylic ester (monomeric ethyl methacrylate).[3] This is attained by pouring the ethyl methacrylate in a large-mouthed receptacle, placing the tissue in it and then producing a vacuum (about 700 mm of Hg.). This is easily accomplished by setting the open receptacle containing the specimen in a vacuum-desiccating jar with stout walls. In a period of one half hour to one hour, the air will be entirely replaced by the ethyl methacrylate, and upon readmitting air into the jar, the tissue will sink in the fluid. In the case of highly porous materials, it may be necessary to repeat this vacuum treatment several times before all trapped air has been replaced by the monomer. The colors of the tissue appear to have returned, but they are somewhat duller than normal and the natural texture is still lacking at this point of the process.

The subsequent steps have to deal with the imbedding of the tissue by polymerization of the monomer. In view of the fact that prolonged immersion of the tissue in the liquid ethyl methacrylate causes bleaching, it is desirable to hasten the polymerization by the addition of a catalyst, such as benzoyl peroxide, and

[11] M. Dubin, *Quart. Jour. Exp. Physiol.*, 24: 31, 1933.
[1] H. G. Knight, SCIENCE, 86: 333, 1937.

† Also of the College of the City of New York.
[2] Max M. Strumia and John J. McGraw, *Jour. of Lab. and Clin. Med.*, 28: 9, 1140–1155, June, 1943.
[3] Obtained from Rohm and Haas Company, Philadelphia 5, Pa.

by cautious use of heat. The simplest technic may be summarized as follows:

(1) Dissolve benzoyl peroxide in ethyl methacrylate, in the proportion of .2–.3 per cent.

(2) After adding a porous clear boiling chip, bring a sufficient amount of this mixture to boil over a hot plate. Avoid an open flame, as the material is inflammable. Boil the material (approximately 115° C.) for about one minute and then cool immediately with running water to about 50° C. Polymerization is an intensely exothermic reaction, and cooling must be done rapidly, otherwise the heat production will be so intense as to cause boiling over and solidification in the form of an opaque mass. Allow the ethyl methacrylate to remain in a closed receptacle (avoid rubber) at plus 50° C. until complete solidification is obtained. About 20 per cent. shrinkage in the volume of the material occurs during polymerization and allowance must be made for this loss.

(3) Remove the piece of tissue saturated with ethyl methacrylate from the liquid monomer, place it upon the base of "Plexiglas" thus prepared, and immediately cover with the ethyl methacrylate-benzoyl peroxide mixture which has been polymerized previously to a syrupy consistency. Polymerization to syrupy consistency is accomplished exactly as outlined under 1 and 2, but the process is stopped when the proper viscosity is obtained. The trapping of air bubbles during this procedure should be carefully avoided. If this occurs, remove by means of a vacuum in a desiccator as previously outlined.

(4) Close the container and place at about 50° C. and allow polymerization to proceed until the mass is thoroughly solid. Polymerization occurs more rapidly at higher temperatures, and more heat may be applied gradually until a temperature of about 70° C. is reached in two to three days. It is desirable, when polymerizing at temperatures higher than 40–50° C., to reduce the height of the layer of the liquid monomer to about 10 mm. Successive layers may be added as desired.

(5) The glass receptacle is then broken and the mass of solidified acrylic resin containing the imbedded tissue is removed. The block is generally clear enough for viewing the specimen without further work. It may, however, be readily cut and polished so as to obtain a more finished product. For large flat slices of organs, a form can easily be obtained by properly binding plates of thick glass with parchment paper.

Any object made by casting an acrylic resin may "craze" unless it is given an annealing treatment. This "crazing" is seen initially as an iridescent effect on the surface of the material and may eventually result in a network of fine cracks extending some distance into the solid mass. In order to prevent "crazing," after any cast object has been machined to the approximate finished shape, we recommend that it be subjected to a temperature of 100–115° C. for one-half hour.

The organs thus imbedded have the original size and shape and retain the normal texture to a remarkable degree. The color is somewhat less brilliant than it was originally, but if the period of polymerization is not too long, it may be satisfactorily preserved. The color has been found to be permanent in mounted specimens even on continuous exposure to sunlight for several months.

Fatty tissues are not so suitable for this type of imbedding. Some organs, such as the liver, have a tendency to release pigment, which causes the imbedding mass to have a slight discoloration. This does not seem, however, to interfere with the general appearance and preservation of the specimen. If the tissue is thin, a certain degree of transparency is attained, which in many cases is desirable.

This process offers what appears to be a most promising method of preservation of normal and pathological specimens for teaching and museum purposes.

Further studies on this procedure are in progress. For the present, the method outlined appears most applicable for the preservation, without shrinkage or loss of color and texture, of small organs, embryos, little animals, fleshy insects and tissues with delicate structure.

We are indebted to Dr. D. S. Frederick, Dr. H. T. Neher and Mr. Hiltner of the Rohm and Haas Company for their helpful assistance in carrying out this work.

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THE ROMANCE AND ENGINEERING OF FOOD PRESERVATION[1]

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THE ELEMENTAL FOOD CYCLE

NATURE has provided a cycle for the conservation of the plant foods of this earth from one generation to another. Man in creating certain processes of civilization has defeated some of the purposes of nature by diverting constituent parts of the plants and animals from this cycle to uses for commercialized civilization.

In this diversion process these essential elements have been directed into modern sewage systems comprised of drainage streams and canals, and hence they have been deposited far from their points of origin. This diversion of the elements from the lands of their origin has slowly impoverished in strategic populated regions the animal-plant cycle established by nature. It has reduced the effective value of the essential elements where life has elected to live, and this to a critical degree especially in some regions.

It is very significant and fortunate that many of the elements to create food for living organisms are inexhaustible. As an example, carbon, oxygen, nitrogen and hydrogen are found in limitless and bountiful quantities in the air and water. From these elements starch, sugar, fats, fibers and protein are all produced. In other words, these several foods are made from unlimited constituents of air and water, transformed under the influence of the sun by the several botanical and biological processes into edible products. Chemically, each of these products originates from an inexhaustible source of supply.

On the other hand, many of the essential plant food elements that are contained in the soil are exhaustible. Potash, phosphate, calcium, magnesium, sulphur, iron,

[1] Address of the retiring vice-president and chairman of Section M (Engineering), prepared for the New York meeting of the American Association for the Advancement of Science.

copper and manganese when joined with some of the inexhaustible elements from the air and from water give us the most common organic compounds that occur in various forms in vegetables, in flesh and in bone structure. These organic compounds might be found in the form of wheat, cottonseed, corn, carrots, potatoes, bacon, mutton, beets, soybeans, etc., yet only a very small part of even these compounds are exhaustible. One hundred pounds of corn, for instance, contains only about one and one-half pounds, while a whole ton of tomatoes contains not over ten pounds of exhaustible elements. Table 1 shows the exhaustible element relationship of these and other food products.

TABLE 1

TABLE SHOWING EXHAUSTIBLE ELEMENTS NECESSARY TO PRODUCE ONE HUNDRED POUNDS OF FOOD PRODUCT

Name of product	Exhaustible elements expressed in pounds necessary to produce one hundred pounds of edible product
Apples	.5
Bananas	1.
Bacon	5
Beef steak	1.5
Butter	4.
Chicken	1.5
Corn	1.5
Cottonseed	5.5
Milk	1.
Oats	5.
Oranges	1.
Peaches	1.
Potatoes	1.
Raspberries	1.
Soybeans	7.
Tomatoes	.5
Wheat	2.5

H. A. Morgan, formerly president of the University of Tennessee, and later chairman of the Board of the Tennessee Valley Authority, points out that since nature did not anticipate and provide for the use of her mineral elements and their resultant plant and animal compounds by man except as they should remain in the animal-plant cycle, eventually man must look forward to restoring the continuity of nature's program or he must follow the elements discharged into the rivers and take up his abode in the deltas and the flood lands. This procedure is not visionary, as is evidenced by some civilizations that have already had to adopt this method of feeding their multitudes.

In Fig. 1 is shown diagrammatically the interdependence of animal and plant life in the program of nature. Plant life is devoured or consumed by the animals, but all the constituent exhaustible elements are returned to the land either as fertilizers or as bone elements. Upon these plant foods new plant life subsists and furnishes the food for further generations of animal life. Our phosphate beds of today are the burial grounds of animal life of the eons of yesterday.

Fig. 2 indicates how man has upset the continuity of this plan by diversion of essential elements through the transportation and sewage systems of present-day civilization. Examples are multiple of man's upset of this natural sequence of fertility restoration.

For the most part each plant and each animal uses the same elements for its existence. Sixteen ele-

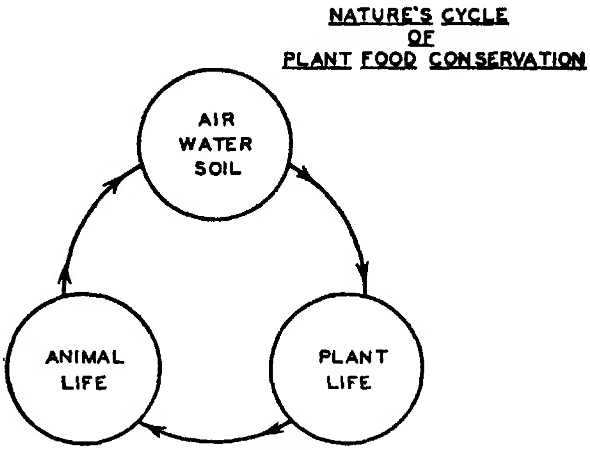

FIG. 1.

ments of the known ninety-two furnish almost the entire needs of the animal and plant life of the world. These are shown in their relation to each other in Tables 2 and 3. Of these sixteen, the three most

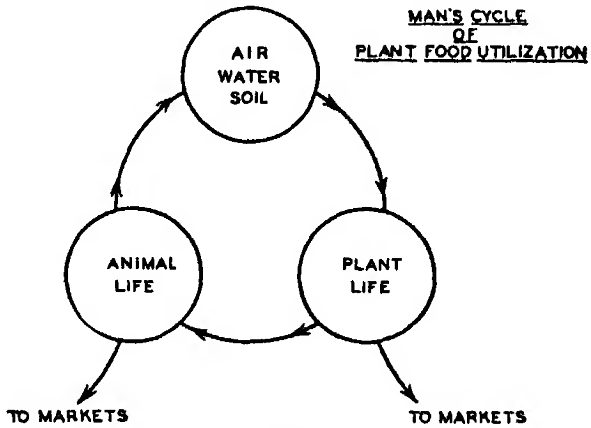

FIG. 2.

important and critical food elements are nitrogen, potassium and phosphate.

Of nitrogen there is a supply of twenty million tons over each square mile of the surface of the earth.

Of potash there is a fairly uniform supply distributed in the crust of the earth on all continents. There is no present evidence that we shall ever have a world shortage.

There are, however, real limitations of the third element, phosphate. Fortunately, nature has played a very important role in preserving for man that phosphate which he now has available. As it occurs in its natural formation most phosphate is locked up for the present and future generations through the implement

of a small key of fluorine. This key modern engineering has been able to turn and thus unlock for our needs by high temperature electric or blast furnaces the phosphate products necessary to replace those that have been dissipated into sanitary sewage channels and transported to distant points of commerce.

Since the exhaustible elements of the earth are those of the soil there exists the idea that the fortunes of civilization depend in the ultimate upon the ability of the occupants of this globe to preserve the soil. This is quite true, but the breakdown can be carried to a more elemental analysis. Primarily, the ultimate fortunes of humanity depend upon the ability of the peoples on the face of the earth to conserve by careful utilization the phosphate portion of the soil for the generations yet to come.

TABLE 2

Inexhaustible Elements Furnished to the Animal-Plant Cycle by Air and Water and the Exhaustible Elements Furnished by the Soil

Air and water furnish the inexhaustible elements	Soil furnishes the exhaustible elements
Carbon Oxygen Hydrogen Nitrogen	Phosphate Calcium Potash Magnesium Sulphur Iron Zinc Boron Iodine Cobalt Copper Manganese

TABLE 3

Food Compounds Produced from Inexhaustible Sources and Those Provided from the Soil

Air and water furnish for plants from inexhaustible elements	Air and water furnish for animals from inexhaustible elements	Soil furnishes from exhaustible elements
Starch Sugar Fats Fibers and textiles	Fats Energy Protein Heat	Organic Compounds Bone Nature did not provide for man's diversion of these compounds from the animal-plant life cycle

More progress has been made in the research and development of phosphate extraction and processing for plant food during the past decade than had occurred before in any one hundred years. The world is beginning to recognize its dependence upon this essential element of human existence. Modern engineering is now providing the procedures and processes to conserve and utilize even the low quality and the isolated beds of the world supply of this strategic element.

Food Habits of Man and His Nutritional Demands

Up to the present era, man has not been as greatly interested in the elemental food cycle and the conservation of our essential food elements as he has been in getting enough to eat each day and in being reasonably sure that he has a sufficient supply for himself and his family for his annual needs.

There is no historical evidence to indicate when man learned his lessons from the instinctive habits of the lower animals that inspire them to store food for the winter months. There is ample evidence that from the dawn of history his eating habits have been very profoundly affected by his ability to conserve the available edible foods over periods of scarcity.

Both in the lower animals and in man the nutritional requirements have been largely determined by instinct. Since the nutritional needs of a man do not change appreciably from one generation to the next, the process of trial and error that has extended over hundreds of years has created a large number of "do's" and "do nots" about traditionally accepted foods.

Since each plant and animal does use approximately the same chemical elements of nature in its growth, but these same plants and animals do vary considerably in quantity of any one element, those people who have been able to utilize a diversified number of plants and meats for their diet have not suffered seriously from any particular deficiency of nutritive food. Food habits, however, have had to adjust themselves to the availability of foods, and in most climates this has been very greatly affected by the facilities to preserve the foods during seasonal or famine periods.

Many of our older nations and civilizations, especially those in hot climates with frequent crop failures, developed food habits primarily centered about cereal and grain foods. These foods could be preserved by the known experiences of the clan or nation over long periods of time. The granary plan of Joseph, repeated in many of its variations in Europe and the Orient, brought about national diets composed mostly of starchy foods. Our physiologists tell us that the granary plan of Joseph left its mark on the residents of Egypt if the tooth diseases of those remains found in the crypts of Egypt is any fair basis of judgment.

For the most part the peoples of a very warm climate also are very partial to sauces and seasoning of a very high and distinctive flavor. Much of this can be traced back to the desire to counteract the taste of partially decayed meat and fish foods through the hot sauces spread thereon.

Even within continental United States in its relatively short history of two centuries the food habits have been very definitely affected by the ability of the people to store and preserve food. Within the north-

ern areas, wheat bread, cellar-stored vegetables and snow- and ice-preserved beef and mutton were used in the winter, but the meat portion of this diet was changed in the summer to pork and chicken when the available preservation facilities for beef and mutton were not workable. On the other hand, within the southeastern states, pork and corn breads were generally accepted as an all-year-around diet. With the lack of snow and ice for preserving the beef and mutton products of the South, pork became the all-year-around meat for the southern table with a liberal introduction of chicken, which could be maintained alive until needed but was small enough to be consumed within a few hours after killing. These examples might be multiplied. A sampling of the tables of the United States prior to 1900 would have revealed that nearly every area was most provincial in its food habits. Since 1900, however, several forces have been at work making possible an effective change in these habits.

Prior to 1900 the nation lacked mobility. It was dependent upon an artery system of railroads to move goods of all kinds. Furthermore, its power systems were highly localized.

Almost simultaneously, three engineering developments changed the features of American life. Out of these three developments, historic changes were destined to bring about decentralization of American industry, new power facilities to American homes and a greater advance in the mobility of man within a quarter of a century than had been experienced from the dawn of history to the year nineteen hundred A.D. These three developments were (1) an interconnected electrical distribution system for all America; (2) mass production of the automobile and the truck, and (3) construction of a network of highways that went to virtually every farm and urban door of the nation.

The interconnected system of electrical distribution made available to most American homes facilities for processing and preserving perishables for use at any period of the year, and through the availability of the trucks and highways thousands of truck loads of fresh vegetables, dairy products, fruits and meats moved daily from one region to another. Florida, Texas and California fruits and vegetables left their semi-tropical gardens daily in winter to the ice-bound centers of the north, even into northern Canada. In the summer the same northern areas would move large tonnages of their perishables to the south.

While food preservation had been carried on within the United States for its entire history, the turn of the century marks the upward swing of many of the most essential processes for the most effective preservation of the grown perishables of the nation.

There is in each area a very definite relationship between family income and class of food consumed. In general each individual in the United States consumes one ton of food each year. If the income is high the purchases will include the more expensive available foodstuffs and *vice versa*. But in the past the locally produced foods that could be readily preserved constituted the principal poundage of human consumption because they were the cheapest. But few have suffered from lack of weight of food even during depressions, though many have found it necessary to make up their meals from low-priced starches and fats when incomes were depressed.

THE ENGINEERING OF FOOD PRESERVATION

For the most part there are four methods of food spoilage or deterioration: (1) odor absorption, (2) enzyme action, (3) bacterial growth and (4) oxidation.

While for the commercial market other factors such as color change, lack of freshness and shrinkage may be given great market consideration, these are closely related to the more serious deterioration factors outlined as above.

Odor absorption has been recognized for centuries in the storage of foods. It has been most serious in the storage of dairy products such as butter, cream and ice cream. In general, the transfer of odors is a function of the temperature of storage. Butters maintained at a very low temperature are much more free of the absorption of odors than when stored warm. Probably this is brought about by two actions. When the affected product is completely frozen or crystalline, then its absorptive capacity is greatly reduced. But also, when the offending odor source is at a low temperature, the volatile odors are at a minimum. When the temperatures of both the absorbing food and the offending source of odor are high, both the absorption capacity and the odor action are intensified.

Enzyme action has been one of the most difficult of the deterioration processes to inhibit. It remains, still, as the process of which we know the least, due to the great complexity and the multiple catalytic activities of the several enzymes.

Some one has referred to enzymes as the unorganized system of ferments in contra-distinction to an organized ferment such as yeast. Another food technologist defines the enzyme as "the catalyst of living cells." Probably a more exact definition is that "an enzyme is a heat-labile catalyst elaborated by living cells yet capable of acting independently of the living processes of the cell."

Bacterial growth has been recognized as of great importance for several generations. Its prominence is evidenced by the acceptance of the study of bac-

teriology as a major science in courses related to health, medical service, sanitation, food preservation and water supply. Unfortunately, the public has been given sufficient misinformation about bacteria so that today to many people all bacteria are harmful. A large portion of the buying public does not realize that many of the food-preserving processes must depend upon certain bacteria for their successful operation, while other bacteria cause deterioration and decay.

Oxidation is generally most active under high temperature conditions. Often the oxidation is associated with one of the other three deterioration actions.

Processes Used to Prevent Deteriorating Actions in Foods

The principal processes of food preservation are (1) drying or dehydration; (2) sterilization and canning; (3) low temperature chilling and freezing, and (4) chemical preservation including pickling, smoking, spicing and fermentation, etc.

Each of these types of food preservation has certain time limitations with the exception of freezing. The recorded discovery reported by the Smithsonian Institution[2] in recent years of mammoth flesh and other animal carcasses many thousands of years of age yet still in edible condition is mute evidence of the permanence of food preservation by sharp freezing.

Dehydration, canning and quick freezing are each of great moment at the present and will be discussed further.

Preservation by Dehydration

Dried foods have been prepared for thousands of years. Either the sun or some artificial source of heat was used to evaporate the excess water. In most of these processes the water was seldom carried lower than 12 to 25 per cent. In no case is there evidence that great care was exercised to maintain controlled treatment of the product in the drying process as between humidity, enzyme action, air velocity and temperature.

Wars have most generally increased interest in the drying of foods, and in recent years dehydration has become an important part of the food programs of armies. Unfortunately, most of the demand for dehydrated foods recedes after each war period, and this recession causes the liquidation of both plants and trained personnel. Probably as a part of the permanent preparedness program of the nation the perishable food supplies areas should maintain, under the Army or Navy direction, base plants for food dehydration, these plants to operate primarily as stand-by units for war emergencies. The nation would then find it could maintain its gains in the science of food evaporation from one period of war emergency to the next.

Much argument can be exercised trying to differentiate between dried foods and dehydrated foods. In the language of the public, no line of demarcation exists between the drying and the dehydration processes. There has been an attempt on the part of food technologists to define the field of activity of food driers as that in which foods are produced down to 10 or 25 per cent. moisture without specific control of the relation of enzyme action, temperature and humidity, while dehydration is defined as a process in which scientific control is maintained as between temperature, humidity, air velocity and enzyme action to evaporate foods to moisture contents of 2 to 8 per cent.

The writer would define dehydration as "the removal of water from food products to required low values of moisture content by a process of controlled temperature, humidity, air velocity and enzyme action, and the resultant product to permit rehydration with a minimum loss of original natural color, flavor, odor and nutritive value."

There are many reasons for dehydrating products for war purposes. Principal advantages of dehydrated foods are:

(1) There is a reduction to a small fraction of the original weight.
(2) The processed product can be compressed into a small cargo package without destroying its rehydration qualities.
(3) The requirements for metal containers are reduced.
(4) They can be subjected to freezing temperatures or hot climates with considerable success.
(5) The process can be operated with a minimum of critical materials.

The principal disadvantages of dehydrated foods are the change of flavor with age, the susceptibility to vermin and the ultimate perishableness of the food.

While dehydration can be carried on by cabinet, drum, spray, rotary cylinder and tunnel driers, fully 80 per cent. of the present supply comes from tunnel equipment.

At the end of World War I, the United States had about twenty dehydration plants in operation, but most of these fell into disuse before 1938. At present this country has over one hundred plants making upward of 100,000,000 pounds of dehydrated products annually. By 1944 this capacity should be quadrupled.

It is reported that Germany's curve of dehydrated plant construction would show three plants in 1900, eight hundred in 1915, eighteen hundred by the close of World War I. It is well known that hydrated and

[2] Annual Report of the Board of Regents of the Smithsonian Institution (1902–1903), p. 621.

ersatz foods are very prominent articles of sustenance in Germany today and probably exceed its 1918 peak several fold.

The 1943 requirements of dehydrated foods in the United States exceed 400,000,000 pounds. Over a billion and a quarter pounds of dehydrated foods have been used in the present war by the Allied nations.

To give some physical impression of what dehydration means to the transportation systems under the present practice, eight carloads of fresh potatoes become one carload of dehydrated product and ten ships for fresh meats can be replaced by one ship for the dehydrated equivalent.

So great has been the contribution made by dehydrated products in this world conflict that never again should the democratic peoples permit their gains in accomplishment in the science of dehydration to revert to a position of subordinated emphasis. And further —if the United States has a vigilant interest in future preparedness, then sufficient productive capacity and yield should be maintained in dehydration plants as a national policy.

Preservation by Sterilization and Canning

While the preservation of food by canning dates back to the early work of Nicholas Appert in France in 1795 which brought him his first public recognition in the national competition of 1807, it did not take on the characteristics of an extensive industrial process until after the introduction of bacteriological control successfully used by H. L. Russell in 1895 for the pea canners of Wisconsin and expanded by S. C. Prescott and W. L. Underwood in 1896 in their epoch-making treatise on "Micro-organisms and Sterilizing Processes in the Canning Industries."

With these notable achievements in the control of food spoilage by the canning process, industry immediately responded, and in the early years of the twentieth century canning plants and can manufacturing flourished in both Europe and America. By the advent of the United States in the present war the canning industry within the nation represented a product output approximating a billion dollars annually with over three thousand producing companies.

While considerable improvements have been made in the laboratory control both from the bacteriological and chemical standpoint during the past forty years, the greatest impetus to the industry has been the development of new machinery to produce the cans, new mechanical engineering developments in cleaning, separating, sterilizing and packing the more than three hundred basic products now coming from the commercial canneries. Coincident with these mechanical developments have come new successes by the chemical engineers in the types of can surfaces and linings produced for the different foods to be preserved.

The excellent results now obtainable by process canning, the low cost of preserving by the canning method and the adaptability of the canning process for preserving the surplus foods in almost every region of the civilized world augur well for its future. There is every evidence that sterilized, hermetically sealed products will continue to be a very essential type of food in our daily life in America and Europe. Economically the preservation of food by canning is sound and the product produced is highly satisfactory.

Preservation by Quick Freezing

Since quick freezing is just emerging into a process that can provide foodstuffs at a price within financial reach of the majority of the people of the United States, it offers new opportunities for industrial expansion. As a new industry, quick freezing presents new problems to be met by the engineer.

Larger amounts of foods can be expected to be preserved by the freezing processes in the generations of the future. The increased facilities of transportation and the widening uses of refrigeration will make possible the preservation of foods by cold for the masses of American people. The fact that freezing is the one process that can provide preservation for an indefinite length of time and that by the new freezing processes the original flavors and colors can be retained, makes it the conservation method that will be most acceptable to the human race. The present state of the art of quick and flash freezing is now advanced to such a stage of perfection that with the release of equipment priorities after the present war, frozen foods can be made available to the purchaser at prices as low as those for hot processed and dehydrated products.

The term "quick-frozen" as applied to food is very elastic and much abused. Many cases are on record of products which have been frozen by methods that required as much as a week for complete solidification, yet they were labeled "quick-frozen." Such loose usage does not induce increased public confidence and acceptance. Too often the practice represents an attempt by some food processor to offer his cold-pack product under a classification that has the highest customer appeal in the food market. A previously proposed definition by the writer states: "Quick freezing is freezing at a rate sufficiently fast that there is no appreciable change in the physical or chemical properties of the product during the entire cycle of freezing and subsequent thawing."

More or less modification of any food may occur when it is frozen. Usually these changes are not apparent until the product has been thawed and in many cases further undesirable changes, due largely to enzyme action, may occur after defrosting is completed.

Theories on Cause of Food Damage by Slow Freezing

Several theories have been advanced to account for the effect of slow freezing. These include the cell-puncture theory, the bursting of the food cells by internal-osmotic-pressure theory, and the theory of the irreversible precipitation of colloidal constituents. Each of these will be discussed in order.

Cell-Puncture Theory. Perhaps the most widespread and persistent hypothesis is the cell-rupture theory, which holds that the cell walls are punctured by growing ice crystals, and that, upon thawing, the cell contents leak out through these minute ruptures. It is also held that, if the size of the ice crystals can be maintained less than the cell dimensions by rapid chilling, no puncturing with its consequent leakage will occur.

It should be borne in mind that foods are not composed of rigid inelastic cells. The walls are resilient and will permit considerable expansion before rupture occurs. Heat is removed from only one side of the cell so that expansion may occur on the opposite unfrozen side.

Microscopic observations have revealed that, even when freezing is exceedingly fast, the smallest ice crystals are much larger than individual cells. Many cells are contained in one crystal instead of *vice versa.* The crystal lattice both inside the cell and in the intercellular spaces is continuous. No tearing or shearing of cell walls has been observed.

Osmotic-Damage Theory. Petersen proposed that damage to foods during freezing is due to the following mechanism: "What crystallizes first in each cell is the pure water. That leaves the remainder of the juice in the cell more concentrated. The resultant increase in osmotic pressure tends to draw the water from the next adjoining unfrozen cell. The water coming into the partly unfrozen cell has a tendency to build onto the crystals between the cells when the rate of freezing is so slow that the system approaches equilibrium." It also accounts for the occurrence of collapsed cells contiguous to large ice masses in slowly frozen foods. However, this theory does not explain the damage which occurs in quick freezing when heat transfer so greatly exceeds diffusional rates at low temperatures that thermal equilibrium is attained before appreciable osmosis can occur.

Irreversible-Colloidal-Change Theory. Almost without exception perishable foods are colloidal systems in which the external or dispersing phase is an aqueous solution. This has led some investigators to the belief that alteration of the colloidal structure is responsible for changes during freezing, storage and thawing. While there are many factors which affect the stability of colloids, it is probable that only three concern the food processor.

(1) The lowering of temperature (distinct from the freezing effect) renders many colloidal dispersions unstable. Examples are the formation of gels from agar, soap and starch hydrosols. This phenomenon is often followed by syneresis, that is, shrinking of the gel and exudation of fluid.

(2) Chemical changes which occur during frozen storage are irreversible. Many of them are due to enzyme action. The rapid deterioration of frozen unblanched vegetables is well known. The "rusting" of oily fish (oxidation of the fat) is very familiar. It is probable that some of the loss of flavor from stored frozen foods may be traced to hydrolysis of esters and oxidation of unsaturated odorous components.

(3) Freezing causes concentration by removing liquid water from the external phase. More concentration, by decreasing the distance between dispersed particles, may bring about critical instability.

Freezing may also effect sufficient concentration of electrolytes to cause "salting out" of hydrophilic colloids. While such precipitation is often reversible, long storage in this state may result in an irreversible precipitate.

An Appraisal of the Theories of Freezing Damage

The freezing-damage theories might be appraised as follows:

Mechanical damage to cellular structures might be caused by ice crystals, especially for some classes of product. When this occurs, there is an internal shredding of the product, caused by growing crystals. The resultant damage is a function of the crystal size and freezing time.

Osmotic injury to cellular structure is possible but probably plays a minor role in the destruction caused by freezing. Water diffuses from unfrozen cells to the faces of growing ice crystals at a very slow rate. The action is irreversible when thawing occurs and might cause internal rupture.

Irreversible changes in the colloid system appear to be the principal cause for slow-freezing damage. Primary or secondary effects of low temperature cause irreversible precipitation of many colloids. This action is independent of cellular structure and explains the effect of freezing upon foods which do not consist of cells. The theory also accounts for the severe damage to some foods and the negligible damage to others when identical freezing technique is employed.

Rapid Freezing Rates Not Essential to All Foodstuffs

Many have a mistaken idea that very rapid freezing is equally desirable for all perishable foods that require preservation by cold. The need of rapid freez-

ing is much more pronounced for some perishables than for others. Furthermore, the colloidal composition of some products is such that even slow freezing affects the structure but slightly.

With most foods that are to be cooked as soon as defrosted, slow freezing is as satisfactory as quick freezing. In the case of meats, slow freezing may even have a tenderizing effect. Furthermore, any leakage of the meat subsequent to defrosting merely results in increased pan juices.

Vegetables with a high starch content display a much different response to the freezing treatment from leafy types that may exceed 90 per cent. of water by actual weight. Well-ripened berries and fruits with a high sugar content present a very different problem from acid and near-ripe fruit products.

Controlled supercooling and favorable colloidal action are utilized in the polyphase freezing process developed by Mr. Luis Bartlett and the author to flash-freeze foodstuffs. Unusually fast heat transfer is secured by direct contact of food with a chilled medium of high viscosity which is composed of three phases: Solid, liquid and vapor, hence the term "polyphase." A typical medium is composed of dextrose, sucrose and water. It is chilled and slowly agitated until a solid phase of finely divided ice particles has formed and is dispersed throughout the liquid. This composition is satisfactorily operated over the range – 2F to – 10F and is metastable at these temperatures.

Articles of food are floated in the cold medium and the slow agitation moves the articles with respect to the fluid and also to each other so the individual pieces are prevented from freezing together. Freezing is so fast that washwater or juices adhering to the food surfaces are at once frozen in place and do not dilute the polyphase medium. This film of ice is proof that diffusion of soluble constituents does not occur, solute is not transferred from the freezing medium to the food, nor does the food lose dissolved solids.

The high rate of heat transfer is due to three factors: (1) The extremely high thermal capacity of the polyphase state. (2) Increase in the thermal conductivity of the fluid film by the suspended ice particles. (3) Almost complete elimination of food supercooling by the "seeding" effect.

The polyphase medium removes heat approximately twice as fast as a liquid medium under identical operating conditions. Polyphase media, composed of water and sugars, may be operated in the metastable state at temperatures as low as – 10F, while syrups employed in food freezing are seldom operated below + 3F. Thus it is possible by employing the polyphase media to chill foods in a fraction of the time required by liquid media under ordinary operating conditions.

An important advantage of heat-transfer fluids which can be operated at subzero temperatures is that freezing is completed in one operation and no heat is removed in the storage room. By eliminating this period of exceedingly slow cooling, less irreversible damage to the colloidal structure occurs. Furthermore a more immediately practical result is that the food does not freeze into a solid mass in the container. Each piece retains its individual character so that it may be removed without disturbing the remainder and repackaging in smaller packages is easily accomplished.

Summation: The engineering profession of the world can be expected to give more attention to the animal-plant food cycles in the years ahead and to determine new methods of preserving for complete utilization the critical and exhaustible supplies of plant foods for the generations yet to live. Coincidentally with this obligation which the engineer must assume, there is the romantic but very real task ahead of applying the same intensive interest in the ultimate preservation of foods as the agriculturists have displayed in producing them.

The food preservation arts and sciences have now progressed forward far enough that the engineering profession can well assure the world that diets can henceforth be determined on the basis of what is good for man. With the coordination of our implements of electrical power, internal-combustion engine. propelled transportation, excellent network of roadways and mechanical inventions, and with the competent support of the food technologists, the bacteriologists and the chemists, the engineering profession should be able to assure the multitudes that the world's ability to preserve is now prepared to equal the world's capacity to produce food. When complete coordination is effected, and production, preservation and distribution become daily realities, then the profession will have reached new heights in engineering, achievement, statesmanship and service.

PUBLIC HEALTH IN THE U.S.S.R.[1]

By Dr. C.-E. A. WINSLOW

YALE UNIVERSITY

DURING a period of rapid demolition and rebuilding of Yale University a student was showing his father about the campus and the father said, "What is that building?"

[1] Address at the Science Panel of the Congress Celebrating the Tenth Anniversary of American-Soviet Relations, New York, November 9, 1943. The complete proceedings of the Science Congress including the Medical Session will be published at a later date by the National Council of American-Soviet Friendship.

"Which building?" asked the boy.

"Oh," said his father, "you didn't look quick enough. It's gone."

Russia, since the October Revolution, has been like that; and I can, unfortunately, bring you no up-to-date picture of its kaleidoscopic changes. My last visit to the Soviet Union was in the summer of 1936 as a member of a mission of health experts from the Health Organization of the League of Nations, which was invited to study the health program of the Union and which traveled from Leningrad to Batum, from Kiev to Gorki, with that purpose in mind. During the past seven years, the opportunities for intimate scientific contact have been limited, so that I can only report on one passing phase of a panorama of progress. My picture of 1936 has, however, the advantage of earlier knowledge, since I spent the summer of 1917 in Russia as a member of a Red Cross Mission and left Leningrad on the night that the sailors moved in from Kronstadt to inaugurate the October revolution, whose anniversary is celebrated to-day.

To take one concrete illustration. In 1917, the sewage of the city of Moscow was disposed of by irrigation on vast sewage farms, one of the most ancient methods of sewage treatment, and one which—to the best of my knowledge—is still in use at Paris and Berlin. In 1936, this procedure had been replaced by an activated sludge process—one of the most modern and scientific in the world.

By 1935, the death rate from diphtheria in the larger Russian cities had been reduced to one fifth of what it was in 1913; and the incidence of syphilis, as measured by a greatly improved machinery for reporting, had declined to a similar extent. The infant mortality rate and the total death rate from all causes had fallen to about one half of the figure for 1913.

During the three years ending in 1935, 170 million vaccinations for smallpox had been reported for the Soviet Union. Typhus and cholera, which had spread disastrously during the terrible phase of civil wars, had been brought under control. We saw a well-equipped Anti-Plague Institute at Rostov, where comprehensive plans were being made for combating the wild rodent carriers of plague which threaten the Volga region and the Caucasus as they threaten our own West Coast states. At Novorrossisk, we visited an excellent quarantine station for protection against the importation of disease. Malaria and dysentery remained a major menace—as they remain to-day over a major portion of the earth's surface; but substantial progress had been made—particularly in Georgia and the Crimea—in control of malaria through anti-mosquito measures and local centers for treatment with atabrine.

The most outstanding feature of the whole public health program was perhaps its provision for the care of maternity and infancy. The Soviet Union was keenly interested in its mothers and children. Research and general planning was carried out by the Clara Zetkin Central Institute for Maternity and Infancy at Leningrad where the latest advances were being studied in control of communicable diseases (the use of BCG vaccine, for example) in nutrition; in child psychology and kindergarten technique. Well-equipped hospitals and infant welfare stations had been established in the cities, and smaller centers were being developed throughout the rural areas, so far as limitations of personnel and equipment would permit. To facilitate the rapid increase in industrial employment of women, welfare stations and day nurseries had been established in the factories, in the Parks of Culture and Rest and in the railroad stations on a scale which we should do well to emulate in this country in the present war emergency. All in all, I am inclined to think that the Maternity and Infancy Program of the Soviet Union in 1936 was the most intelligent and far-reaching program of its kind in the world.

A second major emphasis of the Union health campaign was on the health of the industrial worker. Here, the center of research was an Institute of Industrial Diseases in Moscow with hospital and out-patient services of its own and where scientific investigations of the first order were carried out on mercury and other occupational hazards. In the factories, themselves, as, for instance, in the Molotov automobile factory at Gorki, we saw excellent hospitals and polyclinics and day nurseries for the workers—an exceptional model plant, to be sure, but one which would be hard to match in the model plants of other lands. Of particular interest was the provision of rest houses and sanatoria where the worker could spend his holidays or where the tuberculosis case or convalescent could be sent for longer periods. Nearly all the luxurious villas of the ancient aristocracy—in the Crimea, for example—were in use for this purpose; and many larger new institutions had been built, such as the magnificent sanitarium for the Red Army at Sochi. Some of these institutions were for children; and one of my most unforgettable memories of the summer of 1936 is the Young Pioneer Camp on the Crimea near Yalta, a vacation camp for children from all over the Union who had distinguished themselves by some distinguished service to the state. After a brief ceremony on the playing field (in the nature of a Boy Scouts' Parade) the formation broke up and the boys rushed up to our seats to make friends. With one of them firmly attached to each hand, we went up the hill to supper; and I discovered

that one of my new-found friends' good deed had been the prevention of a train wreck by giving warning of an accident to the line.

The scope of the health program of the Soviet Union is, of course, a broad one, since it recognizes no artificial boundary between prevention and cure and provides medical care to all the people as a right of citizenship—just as we provide education in the United States. As rapidly as circumstances would permit, hospitals, polyclinics (industrial and regional) and the services of regional physicians and nurses had been provided, organized to provide routine preventive service, prophylaxis and medical care. Medical education—as in all continental European countries—was conducted by the state but with the interesting provision—without cost—of refresher courses for physicians every three years. Vigorous efforts were being made to increase the meager supply of hospitals and physicians available during the pre-revolutionary period. In Georgia, for example, the hospital beds had been multiplied fourfold and the number of physicians, tenfold, since 1913. Five hundred and seventy-seven primary medical centers had been established in the rural areas of that province alone.

The Soviet Union fully recognized the importance of scientific research, as the basis for progress in medicine and public health. I have mentioned several of the lavishly equipped institutions which guide progress in the fields of maternity and infancy and in industrial hygiene. I can not omit reference to the Central Institute for Nutrition in Moscow with its three divisions for physiology of nutrition, food sanitation and food technology; the institute directed by Dr. Lena Stern at Moscow; and that mecca for physiologists, the Pavlov Institute outside of Leningrad. A monograph by A. D. Speransky on "A Basis for the Theory of Medicine," published shortly before our visit, is one of the most challenging approaches to the basic physiological problems of disease which has appeared in any country in the present century.

Seven years in the history of Soviet Russia is a long time as measured by the slow-motion progress of less dynamic lands. The one thing which the Commissar for Public Health emphasized to us was "We are never satisfied." What new progress was made between 1936 and 1941 we do not know. How the terrific sufferings of the past two years have set back that progress, we do not know. But of some things we may be sure. The Soviet Union is dedicated to the physical and emotional and social health of its people, with an unusually vivid consciousness of that aim. It has advanced on the road to that ideal at an almost unparalleled rate. It will go forward on the road after the war is won and the threat of Nazidom lifted from the world. We want to share with the health leaders of the Soviet Union in their glorious tasks. We want to help them—if in any way we can. We want to learn from them as they go forward in their future advance. We are comrades together, not only in the war for the four freedoms but in the longer even more fundamental war for the health and welfare of the human race.

OBITUARY

RUSSELL HENRY CHITTENDEN

WITH the passing of Russell Henry Chittenden on December 26, 1943, an era in physiological chemistry in the United States may be said to have come to a close. "The first definitive laboratory of physiological chemistry in America for the instruction of students was established in the Sheffield Scientific School at Yale University in 1874";[1] the direction of it was placed in the hands of Chittenden, a young man eighteen years of age, who at that time was a candidate for the bachelor of science degree in the Sheffield Scientific School. This young man was born in New Haven, Conn., on February 18, 1856, the son of Horace Horatio and Emily Eliza Doane Chittenden; his family traced back to William Chittenden, who came to this country from the parish of Cranbrook, Kent, England, in 1639. The young man was educated in the public schools of New Haven and prepared for Yale in the French Private School there. At first he intended to study the classics, but a growing interest in natural science turned him toward the study of medicine and therefore matriculation with the Sheffield Scientific School. At the age of nineteen Russell Chittenden received his B.S. degree, having offered a thesis entitled "Glycogen and Glycocoll in the Muscular Tissue of Pecten irradians," which was published in the *American Journal of Science and Arts*. Its translation into German and subsequent publication in Liebig's *Annalen der Chemie* was destined to be the open sesame for the young man's acceptance as a student in 1878 in Kühne's laboratory at the University of Heidelberg. The young man had made his plans to enter Hoppe-Seyler's Institute of Physiological Chemistry at Strassburg but was disappointed by what he saw when he arrived; neither the city nor the laboratory made a favorable impression on him. To use his own words, "Intuition is not to be wholly ignored, and I went on to Heidelberg

[1] R. H. Chittenden, "The Development of Physiological Chemistry in the United States," p. 33, American Chemical Society Monograph Series. Chemical Catalogue Co., New York, 1930.

with the feeling deep in my heart that the place where such men as Gmelin, Tiedemann, Bunsen, Kirchoff, Helmholtz and Kühne had worked should give inspiration and opportunity, and that there would be found an environment more in harmony with my needs." Kühne had remembered the article in Liebig's *Annalen*, and welcomed him.

No one can read the opening chapters of Chittenden's monograph, "The Development of Physiological Chemistry in the United States," without realizing that the author began his work when the foundations of this science were being laid in this country, and through his own pioneer work did much to give the science the standing and place it now holds in the present academic scheme of things. Stimulated by his association with Kühne, Chittenden returned to New Haven fired with the idea that his laboratory should develop physiological chemistry as a broad biological course of study not restricted to the requirements of any branch of applied science (its use in medicine, for example) but devoted "to the expansion of physiological knowledge in all its varied aspects." His more immediate research interests were concerned with the requirements for the doctorate which were met in 1880 when he was given his Ph.D. degree by Yale. His appointment as professor of physiological chemistry came in 1882; this post was held for forty years when he retired as professor emeritus. In 1898 he assumed the directorship of Sheffield Scientific School and served in this capacity until his retirement in 1922.

Between 1875 and 1883 twelve papers were published reporting studies made in the new Laboratory of Physiological Chemistry. The year 1884 saw four papers through the press, one of them dealing with albumoses written jointly with Professor Kühne and published both in German in the *Zeitschrift fur Biologie* and in English in the *American Chemical Journal*. The influence of the year spent at Heidelberg seems evident in the eleven publications that appeared in 1885, seven of which dealt with various aspects of amylolytic and proteolytic digestion. Students in this field will remember that it was Kühne who gave us the word *enzyme* (in yeast). Further development of the theme stands out in the ten papers found in the second volume of collected papers covering the year 1885–86, five of which report observations concerning digestion or the chemical properties of some of the products of proteolytic activity. Volume III of Collected Papers, covering the period 1887–88, comprised nine communications, four of them again related to this same topic. In similar fashion one might review the publications of each of the succeeding years and show that the predominant topic of interest was the phenomena of digestion.

To students of nutrition Chittenden is probably best remembered for his work on the amount of protein needed for proper maintenance of the adult organism. This problem attracted his attention in the autumn of 1902 and early part of 1903, when Mr. Horace Fletcher, the advocate of extensive chewing of food in order to secure from it the maximum of its nutritive value, spent several months in New Haven, "thereby giving an opportunity for studying his habits of life." This eventually led to nitrogen equilibrium studies on professional men (Chittenden and four colleagues in his laboratory), eight college students and thirteen volunteers from the U. S. Army. It was shown that nitrogen equilibrium can be maintained with a daily intake of protein "one-half of the 118 grams of proteide food called for daily by the ordinary dietary standards" (by which was meant here the Voit standard). These studies also led Chittenden to conclude that "body equilibrium can be maintained on far less than 3,000 calories per day by the brain worker." The detailed report of this investigation appeared in a volume entitled "Physiological Economy in Nutrition" published in 1905. These experiments were again reviewed and interpreted in relation to various aspects of nutrition in a set of eight lectures delivered before the Lowell Institute in Boston in the early part of 1907, and published in a book entitled "The Nutrition of Man." Examination of this latter volume shows that the experimental approach to the problem had been extended to include experiments on dogs.

During the administration of President Theodore Roosevelt, Dr. Chittenden was a member of the famous referee board that passed on the question whether sodium benzoate in foods is toxic. Another public service was rendered during World War I when he served as a member of the executive committee of the National Research Council. After the war he represented the United States on the Inter-Allied Scientific Food Commission, which met in London, Paris and Rome. As further examples of the international position which he held one may cite his membership in the Société des Sciences Medicales et Naturelles de Bruxelles and the fact that he was a corresponding member of the Société de Biologie in Paris.

Dr. Chittenden died in his eighty-seventh year and retained his mental faculties to the last. It was his good fortune, therefore, to see the subject to which very early he had chosen to devote his career develop in the work of two generations after his own. Such an opportunity is not given to many men. What he saw as the fruit of the labors of so many people in a field which he literally started in this country must have given him much personal satisfaction, for it constituted a vindication of his early judgment of the

possibilities in this science. In a very real sense he merited the title which many had conferred upon him years ago, namely, "The Father of Physiological Chemistry in the United States."

GEORGE R. COWGILL

DEATHS AND MEMORIALS

DR. EDWARD BENNETT MATHEWS, professor emeritus of mineralogy and petrography at the Johns Hopkins University, died on February 4 at the age of seventy-four years.

DR. WILLIAM GEORGE MACCALLUM, from 1917 until his retirement last spring professor of pathology at the Johns Hopkins University Medical School, died on February 3 at the age of sixty-nine years.

DR. EDWARD PEIRSON RICHARDSON, John Homans professor of surgery emeritus at the Harvard Medical School, died on January 26 at the age of sixty-two years.

DR. DANIEL M. MOLLOY, who from 1914 until his retirement in 1940 was a field representative in Central America for the International Health Division of the Rockefeller Foundation, died on January 29 at the age of sixty-one years.

ROY A. NORMAN, professor of heating and ventilation in the department of mechanical engineering of Iowa State College, died on January 29.

EDWIN R. PEARSON, for many years a member of the staff of the General Electric Company, where he was a designer of power transformers, died on January 28 at the age of eighty years.

AN anonymous gift of $10,400 has been made to Cornell University to establish a Veranus A. Moore Research Fund, the income of which will be used for research in the department of clinical and preventive medicine. The fund is in honor of the memory of Dr. Moore, who was formerly dean of the Veterinary College at the university.

IN the wish to express their appreciation and regard for Barbara Stoddard Burks, whose death has meant a great loss, personal and professional, to many psychologists and geneticists, her friends are establishing a memorial fund. Because of her activities during five years as chairman of the American Psychological Association Committee on Displaced Foreign Psychologists, it is proposed to use the fund to promote international professional relations among workers in the fields of psychology and genetics—for example, as a loan fund for assistance to European scholars studying or carrying on research in the United States. For the present the administration of the fund will be in the hands of a committee composed of Gordon Allport, Katherine Brehme, Robert Cook, Kurt Lewin, Theodore Newcomb, Lewis M. Terman, Ruth S. Tolman and Robert S. Woodworth. Contributions may be sent to Ruth S. Tolman, 4420 Fiftieth Street, N.W., Washington 16, D. C.

SCIENTIFIC EVENTS

BRITISH NEW YEAR HONORS[1]

THE New Year Honors include the names of a number of scientific workers and others associated with scientific work. The principal honors are as follows:

Knight of the Grand Cross of St. Michael and St. George: Sir George Gater, Permanent Under-Secretary of State, Colonial Office.

Companion of Honor: The Right Honorable R. S. Hudson, Minister of Agriculture and Fisheries.

Knight Commander of the Royal Victorian Order: Sir Harold Hartley, chairman of the Fuel Research Board.

Knights: Professor Ernest Barker, emeritus professor of political science in the University of Cambridge; Professor J. C. Drummond, scientific adviser to the Ministry of Food, professor of biochemistry in the University of London; Professor F. L. Engledow, professor of agriculture in the University of Cambridge; Dr. J. J. Fox, Government chemist; Professor F. R. Fraser, director-general of the Emergency Medical Services; W. T. Halcrow, engineering consultant, War Office; C. R. Lockhart, chairman of the East African Production and Supply Council; T. R. Merton, scientific adviser to the Ministry of Production, formerly professor of spectroscopy in the University of Oxford; J. G. Nicholson, deputy chairman, Imperial Chemical Industries, Ltd.

Companion of the Bath: P. N. Harvey, director of statistics and intelligence, Ministry of War Transport, Department of the Government Actuary; C. Nathan, principal assistant secretary, Ministry of Agriculture and Fisheries.

Companion of St. Michael and St. George: Right Rev. Mgr. C. Gagnon, rector of Laval University, Quebec, and E. B. Hosking, chief native commissioner, Kenya, and Dr. R. C. Wallace, principal and vice-chancellor of Queen's University, Kingston, Ontario, for services to university education.

Companion of the Order of the Indian Empire: Colonel R. H. Phillimore, superintendent of the Survey of India; M. Carbery, director of agriculture, Bengal; Sri Pattipati H. Rama Reddi, director of agriculture, Madras; D. B. Sothers, chief conservator of forests, Bombay.

Commander of the Order of the British Empire: W. A. Akers, a director of research, Department of Scientific and Industrial Research; Professor C. H. Best, professor of physiology in the University of Toronto, for important medical research; Major R. F. Brebner, chairman of di-

[1] From *Nature.*

rectors, Highland and Agricultural Society; Dr. A. N. Drury, director of the Lister Institute, lately a member of the scientific staff of the Medical Research Council; Dr. W. H. Glanville, director of the Road Research Station, Department of Scientific and Industrial Research; Professor D. A. L. Graham, professor of medicine and clinical medicine and dean of the Department of Medicine, University of Toronto, formerly president of the Royal College of Physicians and Surgeons of Canada, for important medical research; Dr. H. W. Meikle, H.M. historiographer in Scotland and librarian of the National Library in Scotland; W. Nairn, president of the Royal College of Veterinary Surgeons; J. M. Stewart, K.C., of Halifax, N. S., for services to university education and also as coal controller; C. Vaillancourt, of Levis, Quebec, for services to war finance and agriculture.

THE ELLA SACHS PLOTZ FOUNDATION FOR THE ADVANCEMENT OF SCIENTIFIC INVESTIGATION

DURING the twentieth year of the Ella Sachs Plotz Foundation for the Advancement of Scientific Investigation, eighteen applications for grants were received by the trustees, thirteen of which came from the United States, the other five coming from five different countries in Europe, Asia, North and South America.

In the twenty years of its existence the foundation has made four hundred and eighty-one grants which have been distributed to scientific men throughout the world.

The list of investigators with the purpose of the research aided in the current year is as follows:

Dr. Georg Barkan, School of Medicine of Boston University, continuation of investigations in the field of sulfanilamide derivatives and related compounds.

Dr. George A. Emerson, School of Medicine of West Virginia University, study of nutritional factors in susceptibility to lethal effects of anoxia.

Dr. Anna Goldfeder, New York University College of Medicine, continuation of studies on the relation between radiation effects and cell viability as indicated by induced resistance to transplanted tumors.

Dr. M. E. Hunter, Royal Victoria Hospital, Montreal, investigation of mild nutritional deficiencies in rheumatic fever.

Dr. Hermann Lehmann, Runwell Hospital, Essex, England, continuation of research on carbohydrate metabolism of isolated tissue.

Professor A. Lipschutz, Santiago de Chile, work on (1) the chemical structure of the steroids as related to antifibromatogenic activity; (2) the metabolic fate of fibromatogenic and antifibromatogenic steroids; (3) the fibromyoma of the prostatic region induced by estrogens in the guinea pig.

Dr. Edward P. Mumford, Stanford University, continuation of basic scientific research bearing on public health and the present emergency in the Pacific.

Dr. Hazel E. Munsell, Government of Puerto Rico School of Tropical Medicine, San Juan, study of the nutritional status, as regards vitamins, of sample populations of Puerto Rico.

Dr. Carl Neuberg, New York University, continuation of work on carbohydrate metabolism of microorganisms and animal cells.

Dr. Herbert Silvette, Medical School of the University of Virginia, investigations of the effect of low barometric pressure on renal function and on the action of drugs on the kidneys.

Thorndike Memorial Laboratory, Boston City Hospital, (Professor George R. Minot, director), in recognition of Dr. Francis W. Peabody's services to the foundation.

Professor Bernhard Zondek, Rothschild Hadassah Hospital, Jerusalem, continuation of investigations dealing with impairment and stimulation of the functions of the pituitary gland and especially of the gonadotropic hormone of the anterior pituitary lobe.

In their first statement regarding the purposes for which the fund would be used, the trustees expressed themselves as follows:

> For the present, researches will be favored that are directed towards the solution of problems in medicine and surgery or in branches of science bearing on medicine and surgery.
>
> As a rule, preference will be given to researches on a single problem or on closely allied problems; it is hoped that investigators in this and in other countries may be found, whose work on similar or related problems may be assisted so that more rapid progress may be made possible.
>
> Grants may be used for the purchase of apparatus and supplies that are needed for special investigations, and for the payment of unusual expenses incident to such investigations, including technical assistance, but not for providing apparatus or materials which are ordinarily a part of laboratory equipment. Stipends for the support of investigators will be granted only under exceptional circumstances.

In the past few years the policy outlined in paragraph 2 has been neglected. Grants will be given in the sciences closely related to medicine without reference to special fields. The maximum size of grants will usually be less than $500. Applications should be sent to Dr. Joseph C. Aub, Massachusetts General Hospital, Fruit Street, Boston, Mass.

FUNGI FOR PENICILLIN PRODUCTION

A PROJECT is being organized at the University of Minnesota Agricultural Experiment Station, Division of Plant Pathology on Botany, to survey Penicillia belonging to the *Penicillium notatum* group and also species of *Aspergillus* for the production of penicillin. The project is under the supervision of Dr. E. C. Stakman. Cultures of organisms are desired, and individuals are requested to forward isolations of the groups of fungi mentioned to the laboratory indicated.

Isolations known to produce penicillin are especially desired.

Individuals who wish to survey other fungi for penicillin activity can obtain directions for a standard technique from the U. S. Department of Agriculture Regional Laboratory at Peoria, Illinois.

ALBERT L. ELDER,
War Production Board
Coordinator of Penicillin Program

THE NEW YORK BOTANICAL GARDEN

DR. WILLIAM J. ROBBINS, director of the New York Botanical Garden, speaking at the annual meeting of the garden in January, outlined the projects which had been approved by the City of New York shortly before the end of the year. The work to be done out of doors is in part necessitated by the widening of highways adjacent to the grounds of the garden.

Plans for rebuilding the Museum and Administration Building are being drawn under a contract awarded jointly to the firms of Aymar Embury II and of Skidmore, Owings and Merrill, architects. The remodeling of the building, erected forty-five years ago, is expected to cost $900,000. When added to improvements on the grounds this will bring the total expenditures for alterations to be carried out immediately after the war to the sum of $1,750,000.

The plans include the erection of a restaurant and comfort station north of the main conservatories, and complete re-landscaping of this area. Major Gilmore Clarke has been commissioned to prepare the final plans and specifications. His assignment also includes the re-designing of the system of roads and bridges through the grounds. His basic plan has already been approved by the Board of Managers. A new rose garden, the design of which was accepted at the annual meeting last year, will be established in the vicinity of the conservatories.

Preliminary plans for the reconstruction of the interior of the Museum and Administration Building call for a new main entrance which would lead visitors directly into a small museum on the ground floor. Most of the present museum exhibits will be stored for use as reference collections. The lecture hall, where many of the courses are given as well as the free lectures on Saturdays and occasional special conferences and programs, will be completely remodeled, with improved stage, seating, lighting, ventilation and projection equipment.

A self-service elevator is to be installed for the use of the staff. Increased space will be provided for the herbarium, which, with more than 2,000,000 specimens now on hand, is growing at the rate of nearly 40,000 specimens a year. The library of 50,000 bound volumes is increased each year by about 700 volumes and many thousands of periodicals, pamphlets, separates, etc. Additional office and working space for members of the staff, classrooms for lectures and laboratory practice, are also planned. Laboratories for plant pathology, physiology and genetics, in addition to rooms for photography and photostating, as in the present building, will be provided. There will be a rare book room for the library, and arrangements will be made for fumigating all herbarium specimens.

THE OPTICAL SOCIETY OF AMERICA

THE winter meeting of the Optical Society of America will be held at the Hotel Pennsylvania in New York City, on March 2, 3 and 4. The Inter-Society Color Council will meet on March 1, one day earlier, at the Hotel Pennsylvania. There will be a session for the discussion of Small Color Differences at 9:30 A.M., and an afternoon session at 2:30 P.M. for the discussion of other topics and the transaction of council business.

On Thursday, March 2, at 2 P.M. there will be a symposium of invited papers given before the Optical Society on the Ostwald Color System, and on Friday, March 3, at 10 A.M. a symposium of invited papers on "Infrared and Organic Chemistry." At 2 P.M. there will be a third symposium of "ten-minute" papers on "Infrared and Organic Chemistry."

On Friday evening an informal dinner is planned at which Dr. W. W. Coblentz, physicist of the National Bureau of Standards, will present some reminiscences. The dinner will be followed by an address by Dr. R. Bowling Barnes, director of the Division of Physics of the Stamford Research Laboratories of the American Cyanamid Company, who will speak on "Natural and Synthetic Rubber, Physical Methods of Analysis." There will be sessions for contributed papers on miscellaneous topics on Saturday.

The meeting will be open to non-members. Those who desire to receive the advance program or other information should address their requests to Dr. Arthur C. Hardy, Secretary, Optical Society of America, Massachusetts Institute of Technology, Cambridge 39, Massachusetts.

OFFICERS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

OFFICERS of the American Association for the Advancement of Science have been elected as follows:

President:
Anton J. Carlson.

Vice-presidents:
Mathematics, J. L. Walsh, Harvard University.
Physics, Albert W. Hull, General Electric Co., Schenectady.
Chemistry, Arthur J. Hill, Yale University.

Astronomy, Seth B. Nicholson, Mt. Wilson Observatory.
Geology and Geography, Howard A. Meyerhoff, Yale University.
Zoology, George T. Hargitt, Duke University.
Botany, R. E. Cleland, Indiana University.
Anthropology, J. Alden Mason, University of Pennsylvania.
Psychology, Edward C. Tolman, University of California.
Social and Economic Sciences, Stanley D. Dodge, University of Michigan.
History and Philological Sciences, E. B. Krumbhaar, University of Pennsylvania.
Engineering, I. Melville Stein, Leeds and Northrup, Philadelphia.
Medical Sciences, Oswald T. Avery, Rockefeller Institute for Medical Research, New York.
Agriculture, R. J. Garber, U. S. Regional Laboratory, State College, Pa.
Education, Harold F. Clark, Columbia University.
Permanent Secretary, F. R. Moulton.
General Secretary, Otis W. Caldwell.
Treasurer, W. E. Wrather.
Director of Publications, F. L. Campbell.
Assistant Secretary, Sam Woodley.

Executive Committee: Burton E. Livingston, the Johns Hopkins University, *Chairman;* Roger Adams, the University of Illinois; Joseph W. Barker, Columbia University; Otis W. Caldwell, Boyce Thompson Institute for Plant Research; Walter B. Cannon, Harvard Medical School; Anton B. Carlson and Arthur H. Compton, University of Chicago; Kirtley F. Mather, Harvard University; F. R. Moulton, Elvin C. Stakman, University of Minnesota, and W. E. Wrather, U. S. Geological Survey.

SCIENTIFIC NOTES AND NEWS

Dr. George Howard Parker, professor of zoology emeritus of Harvard University, in recognition of his work for the advancement of zoology, has been elected a foreign member of the Zoological Society of London.

Three of the four Charles Mayer fellowships of the New York Academy of Medicine, each of the value of $2,000, for "the study of the relationship between precancerous lesions of the mouth, hepatic insufficiency and gastrointestinal disorders," have been awarded to Dr. Harry Goldblatt, professor of experimental pathology at the School of Medicine of Western Reserve University; to the Cancer Research Laboratory of the Mount Sinai Hospital, New York, and to Dr. John R. Murlin, professor of physiology at the University of Rochester. Further applications should be sent to Dr. Mahlon Ashford, secretary of the committee, 2 East 103rd Street, New York, not later than April 1.

The Institute of the Aeronautical Sciences has, as already announced, elected Major R. H. Fleet, of San Diego, president. Vice-presidents elected are Wellwood E. Beall, vice-president of the Boeing Aircraft Company; William K. Ebel, vice-president of Glenn L. Martin Company; Elmer A. Sperry, Jr., vice-president of the Sperry Products, Inc.; and G. M. Williams, vice-president of the Curtiss-Wright Corporation. Bennett H. Horchler has been made executive vice-president; Charles H. Colvin, director of the Daniel Guggenheim School of Aeronautics of New York University, treasurer; Robert R. Dexter, secretary, and Lester D. Gardner, chairman of the council and president of the Aeronautical Archives.

Dr. Gertrude Rand, of the Institute of Ophthalmology of the Presbyterian Hospital, New York City, was the guest of honor on February 7 at a tea meeting at the Hotel Ritz-Carlton, New York City, of the Residence Lighting Forum of the New York Section of the American Illuminating Engineering Society. Dr. Rand spoke on her work on artificial lighting and its relation to the practical study of lighting and vision. George Ainsworth, architect, designer and illuminating engineer, spoke on the practical application of these researches to the lighting of interiors.

The following have been elected officers for 1944 of the Mineralogical Society of America: *President,* R. C. Emmons, University of Wisconsin; *Vice-president,* Harry Berman, Harvard University; *Editor,* Walter F. Hunt, University of Michigan; *Treasurer,* Earl Ingerson, Geophysical Laboratory, Washington, D. C.; *Secretary,* Paul F. Kerr, Columbia University, and *Councilor, 1944–47,* S. J. Shand, Columbia University.

John H. Montgomery, of Fritzsche Bros., Inc., was elected at the annual meeting on January 15 president of the Essential Oil Association of the United States of America.

R. W. Marsh, of the Long Ashton Research Station, has been elected president for 1944 of the British Mycological Society.

Dr. G. Watts Cunningham, Susan Linn Sage professor of philosophy at Cornell University, has been appointed dean of the Graduate School. He succeeds Professor G. H. Sabine, now vice-president of the university. Dr. Cunningham has been professor of philosophy at the university since 1927. Dr. Philip A. Munz, dean of the faculty of Pomona College, has been appointed, effective on July 1, professor of botany and horticulture in the Bailey Hortorium.

Dr. John G. Kidd has been appointed professor of pathology at the Cornell University Medical College and pathologist of the New York Hospital.

Dr. Joseph E. Markee, professor of anatomy at Stanford University, has been made professor and head of the department of anatomy of the School of Medicine of Duke University.

Dr. F. P. Luduena, of the medical faculty of the University of Rosario, Argentina, has become assistant professor in the department of pharmacology of the Medical School of Stanford University, San Francisco, and Dr. Robert H. Dreisbach has been appointed instructor.

T. Thomson, lecturer in the School of Forestry of the University College of North Wales, Bangor, has been appointed the first incumbent of the newly established chair of forestry.

Eugene Paul Polushkin has been appointed associate professor of metallurgy at the Stevens Institute of Technology, and Dr. Frances Hurd Clark has been named assistant professor of powder metallurgy.

Frank M. Stead, associate professor of sanitation at the School of Medicine at Galveston of the University of Texas, has resigned to take charge of studies on industrial hygiene for the California State Board of Health at Berkeley. He will be succeeded by Joe B. Winton, formerly associated with the Harris County Health Department. Dr. J. Allen Scott, senior statistician in the Division of Vital Statistics in the U. S. Bureau of the Census, formerly on the staff of the Rockefeller Foundation in Egypt, has been appointed associate professor of preventive medicine in the field of statistics and epidemiology.

Dr. W. Sherwood Lawrence, instructor at the Medical School of Stanford University, San Francisco, has been appointed associate pharmacologist to the Food and Drug Administration, Washington.

Dr. Fred W. Oberst, of the U. S. Public Health Service Hospital at Lexington, Ky., where he was engaged in biological research on narcotics, has been made head of the newly organized department of biochemistry of the Wm. S. Merrell Research Laboratories, Cincinnati, Ohio.

William A. Lewis, director of the school of electrical engineering of Cornell University, has become consulting electrical engineer to the Armour Research Foundation at the Illinois Institute of Technology and has been named research professor in the department of electrical engineering. Fred J. Vogel, who has been associated with the Westinghouse Electric and Manufacturing Company for the past twenty-four years and who has specialized in the development of power transformers, became professor of electrical engineering on December 1.

Dr. Hugh R. Stiles, of the department of research in biology of the Commercial Solvents Company, has been appointed head of the newly organized agricultural division, with headquarters at Terre Haute, Ind.

William B. Lodge, recently associate director of the division of war research of the Airborne Instruments Laboratory of Columbia University, has been named acting director of the department of engineering of the Columbia Broadcasting System.

The Council of the British Cotton Industry Research Association has announced that Dr. F. C. Toy has been appointed to succeed Sir Robert Pickard, who is relinquishing the post of director of research that he has filled for the last seventeen years. Dr. D. W. Hill succeeds Dr. Toy as deputy director, and Sir Robert Pickard will be consultant to the association.

Dr. Henry E. Meleney, Hermann M. Biggs professor of preventive medicine, New York University College of Medicine, visited Puerto Rico during the week of January 9 as guest of the Puerto Rican Medical Association and the School of Tropical Medicine at San Juan. He addressed the medical association on "Recent Advances in the Treatment of Malaria," and the School of Tropical Medicine on "The Relationship of Clinical Amoebiasis to Various Strains and Growth Requirements of *Endamoeba histolytica.*" On his return through Cuba he addressed a special meeting of the Cuban Branch of the American Public Health Association and the Cuban Society of Preventive Medicine on "Inter-American Cooperation in Medicine and Public Health."

Professor I. E. Melhus and Professor George Goodman, of the department of botany of Iowa State College, have left on an expedition to southern Mexico and northern Guatemala to make a collection and study of varieties of corn. This research is supported by a gift of $75,000 from the Earl E. May Seed Company of Shenandoah, Iowa.

Professor P. J. W. Debye, professor of chemistry at Cornell University, has leave of absence from February 13 to March 20 to enable him to conduct a lecture tour for the Society of the Sigma Xi.

Word has been received by Dr. T. H. Goodspeed, professor of botany and director of the botanical garden of the University of California at Berkeley, who visited South America last year, of a presidential decree authorizing acquisition of the site selected by him at the request of President Rios, and stating that it would be developed according to the specifications he made at that time. The garden will be close to the

city of Valparaiso and will contain five hundred acres of hilly terrain near the sea where there is still a considerable amount of native vegetation. Fifty acres will receive the more intensive development of the conventional botanical garden and will include examples of the most important plant families, particularly the species of those families native to Chile. There will also be an area for Chilean trees and shrubs, one for water plants, another for cacti and other desert plants. The remainder of the area will be a plant preserve where future generations will be able to see and study elements of the native vegetation of central Chile.

A portrait of Nicholas Copernicus, which was painted by Maxim Kopf early last year in connection with the four hundredth anniversary of his death, was formally presented on February 3 to Dr. Harlow Shapley for the Harvard College Observatory by Dr. Stephen P. Mizwa, executive director of the Kosciuszko Foundation. The painting, which measures 48×54 inches and is done in oils, was presented at a regular meeting at the observatory of the Bond Astronomical Club. In presenting the portrait Dr. Mizwa spoke on the "Quadricentennial Tribute to Copernicus" and after acceptance of the gift, Dr. Shapley gave an address on the "Revision of Globular Star Clusters."

The sixth winter meeting of the Industrial Research Institute was held on January 28 and 29, at the Westchester Country Club, Rye, N. Y. A hundred research executives and a number of presidents and vice-presidents of member companies and their guests attended. Louis Ruthenberg, president of Servel, Inc., Evansville, Ind., was the principal speaker at an informal dinner on Friday evening. His subject was "Industrial Research under Free Enterprise."

The Society of the Sigma Xi is encouraging member group activity in non-academic research institutions that qualify because of their participation in, and encouragement of, original research in science. The first group to qualify and to be granted affiliation with Sigma Xi is the Esso Research Club, of Elizabeth, N. J., whose membership is drawn from the chemists, physicists, engineers and other technical research and development personnel of the companies associated with Standard Oil Company of New Jersey. Arrangements are being made for the installation on April 26 of the Esso Research Club by the national officers of Sigma Xi.

The sixth National Geographic Society-Smithsonian Institution Archeological Expedition to southern Mexico, led by Dr. Matthew W. Stirling, chief of the Bureau of American Ethnology, left Washington on January 28 to continue the study of pre-Columbian civilizations. The object of the expedition this year is an archeological survey of the headwater streams of the Tonalá River in the Tabasco, Veracruz, Chiapas and Oaxaca States. Last year a native told Dr. Stirling about a large ruin in the region. No explorer has ever visited the site. The expedition made an unsuccessful attempt to find the ruin, but, with data now in hand it is hoped to reach it for preliminary examination.

It is planned in the near future to open a new College of Engineering at the University of California at Los Angeles. A curriculum in pre-engineering, open to freshmen and sophomores, has already been established. It is expected that curricula in various branches of engineering science will be introduced after the appointment of a dean for the college. First emphasis will be placed on practical aspects of aeronautical engineering.

A Winthrop fellowship in pharmacology has been established at the Stanford University School of Medicine for use in training doctors of medicine in teaching or research in the field of pharmacology. The fellowship is to be financed by a grant of $1,500 from the Winthrop Chemical Company of New York City. An initial instalment of $375 has been received from Dr. J. P. Rice, director of medical research of the company.

The New York Times reports that preparations are underway to convert Winfield Hall, the Long Island Sound estate of the late Frank W. Woolworth, into a chemical and metallurgical institute where university and commercial scientists will assemble for research and conferences to exchange information. Provision will be made for them to live in the residence of the late owner for months at a time. No industrial activities will be conducted at the research center, but limited laboratory facilities will be available in one of the outbuildings for analytical and experimental work for the benefit of industrial chemistry and metallurgy. The legal occupant will be the Reynolds Research Institute, formed by the Reynolds Metals Company and associates. The head of the company, Richard S. Reynolds, Jr., is president of the institute. Application has been made to the Glen Cove Zoning Board for permission to install the institute on the property, which is now assessed at about $200,000.

It is reported in *Nature* that a Soviet scientific commission is now in Novosibirsk organizing a Western Siberian branch of the Academy of Sciences of the U.S.S.R. The academy will establish four institutes in the city: for chemistry and metallurgy, mining and geology, medicine and biology, and transport and power.

McGill University has established a department

of psychiatry and, in association with the Royal Victoria Hospital, Montreal, an institute for research and teaching. Through the generosity of Sir Montagu and Lady Allan, a building and an extensive site have been provided. Facilities for intensive treatment are being set up. The development of research and treatment will be major objectives, and with this in view large and well-equipped laboratories are to be provided. The project is being supported both by the Rockefeller Foundation and by the Government of the Province of Quebec. Dr. D. Ewen Cameron has been appointed to the chair of psychiatry and will also be the director of the institute.

According to a cable to *The New York Times* under date of January 26, the Royal Observatory built at Greenwich in 1675 is probably going to be moved. Sir Harold Spencer Jones, Astronomer Royal, is reported to have said that the proposal of moving has been approved in principle by the Admiralty, but that nothing definite can be done until the King sanctions it. After that the British Treasury will have to be consulted. Sir Harold said in explanation: "We must face the fact that Greenwich is no longer suitable. We used to have a greater record of sunshine than Kew. Now the annual total sunshine at Greenwich is something like 200 hours less than Kew. When the sun gets low sunlight is so weakened by smoky atmosphere that it is impossible to get registrations on the sunshine recorder."

DISCUSSION

THE GENETIC SEX OF INTERSEXUAL GOATS AND A PROBABLE LINKAGE WITH THE GENE FOR HORNLESSNESS

In the Beltsville herd of goats, according to Eaton and Simmons,[1] the Saanen breed produced 11.1 per cent. of intersexes and the Toggenburgs 6 per cent. Paget[2] has found 14.3 per cent. intersexes in the British Saanen breed, but his figure is probably high representing the incidence in herds where the condition has become a serious problem. At Beltsville, the sex ratio was for Saanens 49.3 per cent. males, 39.6 per cent. females and 11.0 per cent. intersexes; for Toggenburgs it was 46.4 per cent. male, 47.6 per cent. females and 6.0 per cent. intersexes. Paget found 193 males, 105 females and 52 intersexes, but his figure for intersexes includes only those kids which were visibly intersexual at birth. The sex ratio in both sets of data is much more normal if the intersexes are regarded as modified females. If this interpretation is correct it would appear that the gene for intersexuality acts only upon the female so that the percentage of intersexes should be doubled to produce the true number of double recessives. Eaton and Simmons furnished strong evidence that the condition is inherited as a simple recessive. If so, some homozygous recessive males should exist which in certain matings would produce 50 per cent. males, 25 per cent. females and 25 per cent. intersexes. Perhaps this may account for the high incidence in Paget's data, higher than that expected in a Hh × Hh mating, if all intersexes are genetic females.

The suggestion that the intersexes are modified females is in line with other evidence. In vertebrates modification of sex is almost always from female to male, extremely rarely from male to female. Evidently intersexuality is produced by the survival and development of the primary sex cords in the genetic female and not by the growth of secondary cords in the genetic male. The genetic male lacks the possibility of producing the necessary second ingrowth of sex cords.

Some years ago the writer observed that all the intersexual goats he had seen (about 200 now) were hornless. Hornlessness is inherited as a simple dominant. Since then much inquiry and observation have failed to unearth a single horned intersex. If they exist they must be very rare. This suggests that there is a close linkage between the two genes, an important point economically, since selection for hornlessness has been practised by pedigree goat breeders for some time. The goat breeders have evidently been increasing the gene frequency for intersex by selecting for hornlessness and are thus doing themselves harm.

S. A. Asdell

Cornell University

[1] O. N. Eaton and V. L. Simmons, *Jour. Heredity*, 30: 261, 1939.

[2] R. F. Paget, *Monthly Jour. British Goat Society*, 36: 57, 1943.

FUNGUS INFECTION OF EGGS OF THE BLUE CRAB CALLINECTES SAPIDUS RATHBUN

In 1941 Dr. Margaret Lochhead, working at this laboratory, observed a fungus-like organism on eggs of blue crabs taken directly from the water and from commercial catches. During the summers of 1942 and 1943 the writers began a program of study aimed to establish the identity of the infection, its effect on the hatching of the eggs, the percentage of crabs in the commercial catches that is infected and the distribution of the infection in Tidewater Virginia.

Professor John N. Couch kindly examined the infected eggs and identified the fungi as *Lagenidium callinectes* Couch, the primary parasite, and *Rhizophidium*, sp., which may be either parasitic or saprophytic (Couch, 1942).[1]

Experimental data indicate that infected eggs are usually below the normal size. Whereas uninfected eggs under optimum conditions in the laboratory gave a 70 to 90 per cent. hatch of normal first-stage zoeae, fungus-infected eggs under similar environmental conditions either failed to develop to the hatching stage or hatched into prezoeae, considered to be abnormal. The prezoeae rarely survived longer than forty-eight hours.

In 1942 infected and uninfected egg masses were suspended in the York River to determine the effect of the fungi on egg development under natural conditions. The infected eggs failed to hatch, and the fungus grew considerably. The uninfected egg masses showed an abundance of empty egg cases, indicating a fairly normal hatch.

The fungus appears to be quite uniformly distributed throughout the egg masses and is present in eggs in all stages of development.

Random samples of eggs have been examined from widely separated parts of Tidewater Virginia, namely, Rappahannock River, York River, Hampton Roads and Lynnhaven. The results to date indicate marked regional variations in the per cent. of infection.

The parasitic fungi represent an important biological factor that occupies a place with certain physical factors, such as low salinity, that are known to greatly reduce the per cent. of hatch (Sandoz and Rogers).[2] In light of the hatching results obtained, the value of protecting heavily infected egg-bearing crabs against commercial use appears questionable. Therefore, in selecting and evaluating a crab sanctuary for the protection of brood stock, attention should be given to determining the extent of parasitic fungus infection present as well as the suitability of the physical and chemical conditions that characterize the area.

Mildred D. Sandoz
Rosalie Rogers
Curtis L. Newcombe

Virginia Fisheries Laboratory of the College of William and Mary and Commission of Fisheries

[1] John N. Couch, *J. Elisha Mitchell Scien. Soc.*, Vol. 58, No. 2, December, 1942.

[2] Mildred D. Sandoz and Rosalie Rogers, *Ecology* (in press).

VITAMIN C IN THE NEEDLES OF SOME CONIFERS

Since the report of Shishkin published recently in Science[1] "that needles of ordinary pine trees contain large quantities of vitamin C," some authors (Dunham,[2] B. Schick,[3] Ch. Macnamara[3] and M. Donnelly[4] have called attention to the fact that the decoction of the needles of the evergreen tree was used with success against scurvy in the early expedition of Jacques Cartier in 1535 and further in the war between Sweden and Russia (1708–09).

This fact has suggested to us the investigation of the vitamin C content of the decoction of some conifers (needles), principally those growing largely in Southern Brazil (Araucaria, Podocarpus).

The determinations were performed on a 5 per cent. extract prepared by boiling the ground leaves with water, as is generally done in the preparation of tea. In other cases the leaves were ground and extracted with 2 per cent. metaphosphoric acid. The determinations were carried out before and after the treatment with H_2S and CO_2.

Tillmans' 2,6-dichlorophenolindophenol titration method was employed. We are indebted to Dr. F. R. Milanez, of the Biological Department of the Rio de Janeiro Botanical Garden, for the samples used in these analyses.

A brief summary of our results is shown in Table 1.

TABLE 1

No. of samples	Species	mg per 100 ml of the extract	
		ascorbic acid	dehydro-ascorbic acid
5	*Araucaria augustifolia (brasiliensis)*	2.7	1.0
5	*Podocarpus Sellowii*	3.3	1.3
1	*Podocarpus Lambertii*	2.8	1.9
2	*Araucaria excelsa*	0.5	0.8
1	*Pinus excelsa*	2.3	1.0

Although ascorbic acid is not present in the decoction in large amounts, the use of the pine-tea would be helpful in some countries where the vitamin C is not readily available.

Gilberto G. Villela

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Rio de Janeiro, Brazil

[1] Science, April 16, 1943, pp. 354–355.

[2] *Ibid.*, August 6, 1943, p. 132.

[3] *Ibid.*, September 10, 1943, pp. 241–242.

[4] *Ibid.*, October 8, 1943, p. 325.

THE TWILIGHT CEREMONIES OF HORSE-FLIES AND BIRDS

In a recent number of Science[1] Leonard Haseman published an article on "The Courting Flights of Tabanids," describing a humming, hovering flight of horseflies which is performed by the males alone and only at the twilight hour. I wish to point out that

[1] L. Haseman, Science, 97: 285, 1943.

this performance of the horseflies is, in its duration and time of occurrence, fundamentally similar to the twilight song of birds. Haseman tells us that in *Tabanus sulcifrons* the performance begins very early in the morning, at a low intensity of light, "a fraction of one foot-candle," and continues for a definite period, "20 to 25 minutes," until the light has reached an intensity of three to five foot-candles; the flight then ceases more or less abruptly. As the season advances, bringing a change in the hours of twilight and sunrise, the hour of the flight changes accordingly. All these details of the horsefly's performance are found, essentially the same, in the twilight song of birds.

Haseman speaks of the twilight flights of the horseflies as "courting" flights; but while the males were performing the twilight flight he could find no females among them and no pairs coupling. Mosier and Snyder[2] express doubt as to whether the early morning flight of *T. americanus* is a courting flight. Hine,[3] in Ohio, found that the mating of *T. sulcifrons* occurred in a very restricted period, about 8 to 8:30 A.M., Standard Time, which would be some three hours or more after the early morning flight. Accordingly, instead of calling the twilight performance of the horseflies a "courting" flight, would it not be well to name it "the twilight hovering flight"?

There is much evidence to indicate that the twilight song of birds has little or no connection with mating. Even if it has a slight connection with mating, that fact can not account for the exact relation of the song to the hours of twilight. Why birds sing a twilight song is not completely understood, but the song has some relation to the bird's daily cycle, his seasonal cycle and his photoperiodism.

We shall speak especially of the daily cycle of the wood pewee, a species of bird whose song is most suitable for statistical study (see the monograph on "The Song of the Wood Pewee").[4] In this species the daily cycle is symmetrical; the male sings a twilight song both morning and evening, and in certain important details the order of events in the morning song is reversed in the evening song, so that the latter is a "mirror image" of the former.

This symmetrical daily cycle anticipates the solar day, being about 17 minutes ahead of it. In other words, the birds keep "daylight-saving time"; but the bird's chronometer is only 17 minutes ahead of the sun, instead of 60 minutes like ours. In the morning the wood pewee anticipates the dawn by beginning to sing when the light intensity is extremely low (about 0.01 foot-candle). In the evening he anticipates nightfall by ending his song while there is still considerable daylight (about two foot-candles).

In saying that the bird "anticipates" the dawn we are not raising the question whether he has any conscious expectation of it. We state only that he acts ahead of time. Every one knows that organisms anticipate the seasons. In the springtime trees often put forth their flowers and leaves before the weather is suitable. In the autumn many birds begin their migration in August; in doing so they are anticipating winter unconsciously, for they certainly do not know that winter is coming. Anticipation, in the sense of acting beforehand, is one of the fundamental properties of life.

We stated that the wood pewee's chronometer is 17 minutes fast, as compared with sun time. We shall explain briefly how the number 17 is derived from our data. In the morning the wood pewee begins to sing at S.d.9°36′. (S.d. = Sun's depression, the vertical angular distance of the sun below the horizon.) In the evening he ends his song at S.d.4°40′. The average of these two is practically S.d.7°, and we regard this as the main dividing point between day and night, for the wood pewee. In the morning he begins to sing 17 minutes before S.d.7°, and in the evening he ends his song 17 minutes before S.d.7°. That gives two measuring points at which the wood pewee anticipates the sun by 17 minutes; and in the monograph cited[4] I have described also four other measuring points which support the conclusion that his daily cycle is 17 minutes earlier than the solar day.

A great many species of songbirds, perhaps all species, anticipate the solar day. Apparently the same is true of the horseflies. Unfortunately, we have no data for both morning and evening from the same species of horsefly. The authors quoted have observed the twilight hovering flight of *T. sulcifrons* and *T. americanus* only in the morning, and *T. giganteus* only in the evening. In regard to this evening performer, Haseman says, "This species seemed to require more light, as they began . . . with a light intensity of about 30 foot-candles and continued for some thirty minutes, ceasing when the light had dropped to an average of about 3 foot-candles." I suggest that this difference in regard to intensity of light is not an inter-specific difference, or not purely such; it is a difference between the morning and the evening performance. If this interpretation is correct, the horseflies do anticipate the solar day. It is to be hoped that field entomologists will find out if *T. sulcifrons* or *T. americanus* ever performs in the evening, or *T. giganteus* in the morning; if so, this will give opportunity to answer definitely the question of their anticipation of the solar day.

WALLACE CRAIG

ALBANY, N. Y.

[2] Mosier and Snyder, *Proc. Ent. Soc. Wash.*, 20: 115, 1918.

[3] J. S. Hine, U. S. Dept. Agr. Bur. Ent. Tech. Ser., No. 12, Part II, p. 24, 1906. (Haseman's citation of Hine is not quite correct.)

[4] W. Craig, *N. Y. State Mus. Bull.*, No. 334, 1943.

SCIENTIFIC BOOKS

RULES OF GEOGRAPHIC VARIATION

Darwinism and Geographic Regularities in Variation of Organisms. By E. I. LUKIN. 311 pp. In Russian. Academy of Sciences of U.S.S.R., Moscow-Leningrad.

THE existence of rules in the geographic variation of organisms has been known for more than a century, but until recently these rules were exploited chiefly by Lamarckians as a support for their views. About ten years ago, B. Rensch, himself originally a Lamarckian, conceded that the rules may as well or better be interpreted in accordance with the theory of natural selection. E. I. Lukin, professor of the University of Tomsk, completes the process by insisting that the facts described by these rules are contrary to any form of Lamarckism and compatible only with selectionism. To this reviewer, Lukin's arguments are convincing. But whether one agrees with Lukin or not, there is no doubt that his book, dated December, 1940, but only now received in this country, is the best on the subject in any language. It must be noted in particular that Lukin reviews numerous investigations published by various authors during the last decade and a half in Russian journals which are difficult of access even for those American biologists who read Russian; this fact alone would make the book valuable.

The book consists of three parts—a historical introduction, a summary of the evidence and a general interpretation. The following rules are discussed: (1) Bergmann's rule—in warm-blooded vertebrates races characterized by small body sizes are found usually in the southern, warmer parts of the species ranges, and large races in colder northern parts. Whether or not this rule is applicable to poikilothermal animals is uncertain. (2) In higher plants tall races occur chiefly in humid and short races in drier countries (based on investigations of O. K. Fortunatova). (3) Allen's rule—in mammals and birds the protruding body parts are relatively longer in warm and shorter in cold countries. (4) Gloger's rule—melanin pigmentation in mammals and birds increases in warm and humid and the phaeomelanin pigmentation in arid countries. (5) Darkly pigmented races of insects are found in countries with humid and lightly pigmented races in countries with arid climates. (6) The studies of K. S. Maslova show that the glumes of wheat varieties develop a red pigmentation in countries with much precipitation during the period of the ear development and a black pigmentation in countries which are dry and hot during the same periods. (7) Plants of warm countries form fats which contain greater proportions of saturated fatty acids, while plants of cold countries produce greater proportions of unsaturated fatty acids (N. N. Ivanov and many others). (8) Optimal temperatures for the development of soil bacteria are higher in warm than in cold countries (E. N. Mishustin and others); similar relationships are observed in many animal and plant species. (9) Races of mammals which inhabit localities at high elevations have more erythrocytes and more hemoglobin in their blood than do races of low altitudes; increases of the numbers of erythrocytes and of the amounts of hemoglobin occur when individuals born at low elevations are transferred to high altitudes. N. I. Kalabukhov has, however, shown that no decrease of the number of erythrocytes or of the amount of hemoglobin is observed if the high altitude race of the rodent *Apodemus sylvaticus ciscaucasicus* is kept at a low altitude (the corresponding increases are observed following the transfer of the low altitude race of the same species to the alpine zone). (10) Tropical and subtropical plants are mostly "short day," and temperate zone and subpolar species are mostly "long day" plants; exceptions from this rule are mostly explicable if one takes into account the special biological peculiarities of the respective species.

Every one of the above rules as well as many other facts quoted in the book show, according to Professor Lukin, that the process of race formation is governed by natural selection. The arguments of Lukin, sometimes couched in a sharp polemic language, are invariably interesting and frequently brilliant. His general ideas about evolution are based on the conceptions of modern genetics. This is especially gratifying as a sign that the misguided campaign against genetics waged by the partisans of T. D. Lysenko has spent itself. An echo of this campaign may perhaps be perceived in Lukin's attitude toward Darwin and his selection theory, expressed in several statements such as the following: "First of all, Darwinism is the only right theory, which has splendidly explained the fundamental moving agents of the organic development. Hence, any evolutionary problem may be solved only in the light of Darwinism." What, however, is Darwinism? Darwin himself modified and developed his views during his lifetime. Then came the period of neo-Darwinism with Weismann as the leading representative. In the last decade or two the progress of genetics has led to theories of evolution which this reviewer proposed to label "inductive Darwinism." We may claim for the modern theories an unbroken ideological succession from Darwin's heritage, but we need not go as far as to regard all Darwin's views inviolable. Like any living scientific theory, that of Darwin has changed greatly, and we may only hope that it will continue to evolve and

change further. Probably the most important change which has and is taking place and which should be welcomed is that evolution theories are being removed from the realm of abstract speculations and placed on experimental and quantitative basis.

Among the concluding chapters of Lukin's book, that devoted to a consideration of the parallelism between the phenotypic and the genotypic variability is most interesting. It is well known that organisms frequently respond to environmental changes by adaptive phenotypic modifications; yet the same adaptive characters may be genotypically fixed in races normally living in the corresponding environments (see the above quoted example of the changes in the composition of the blood in low altitude and high altitude mammals). Adaptation may be attained either by development of a norm of reaction which responds favorably to the variety of external conditions in which the species usually occurs or else by development of a variety of genotypes with specialized norms of reaction fitting the different ecological niches. Lukin points out that the history of the species and its biology determine which one of these two methods of adaptation is more efficient. Genotypic specialization is preferable to phenotypic plasticity where an early appearance of an adaptive character in the ontogeny is desirable. For example, skin callosities may develop either as a response of the skin to pressure or as a genetically fixed character arising already in embryos without the stimulus of pressure. The former method exposes the animal to risks during the process of formation of callosities, while the latter protects it from the birth on. Phyletic advances are usually accompanied by genotypic specialization. According to Mashkovcev, the lung development in lower amphibians (axolotl) depends on the functional stimulus of respiration by air; in higher ones the lung development is partly (in frogs) or completely (toad) independent of functional stimuli.

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THE STUDY OF POLLEN IN PEAT

An Introduction to Pollen Analysis (with a foreword by Roger P. Wodehouse). By G. ERDTMAN. 239 pp., 28 plates, 3 portrait plates, 15 text figs., some multiple; new series Plant Science Books, vol. 12; Waltham, Mass.: Chronica Botanica Company; New York: G. E. Stechert and Company. 1943. $5.00.

THE well-known and much-admired Swedish botanist, G. Erdtman, here gives to the world a partial harvest of the many years that he has devoted to the study of pollen analysis. This branch of botanical-geological science stems from the resistance to decay of the cuticle of pollen grains, entrapped in the peaty deposits of swamps, or, to a large extent, in fine-grained muds, silts and sands deposited by various agencies. As peat bogs afford an almost perfect trap for pollen, the preserved pollen represents the pollen rains throughout the period of growth of the bog. Pollen analysis is the process of study of the stratigraphic distribution of pollen, its separation from decayed vegetable matter and mineral grains, its identification and the interpretation of results in terms of the environment of the bog throughout its history. The pollen of plants growing on or near the borders of the bog records the local conditions, whereas pollen of upland plants reflects the ecology of the general neighborhood and hence the climate of the time. In practice 150 grains of tree pollen are counted from each sample in a vertical peat section. Percentages of the tree pollen, omitting corylloid pollen, are calculated and plotted in a graph. Increase or decrease is considered much more significant than absolute percentage of any tree species. Opposite trends, as of spruce and of mixed hardwoods, are considered of the highest importance as indicating a pronounced change in the forest association and hence in climate.

The discovery of these relationships is a noble scientific accomplishment in which Swedish scientists have taken a leading part. Erdtman's historical account somewhat overemphasizes the accomplishments of his countrymen. Nevertheless, it is perhaps fair enough to say that the systematic attack on paleoclimatological problems by means of pollen analysis of bogs dates from von Post's paper of 1916 and is based largely on Lagerheim's techniques. Since 1916, activity in the field has been astonishing. Erdtman's useful biennial bibliographies record an average of 150 papers a year in Europe alone, with contributions from all over the world. The study of the Postglacial and Interglacial peats absorbs most of the workers, but the pollen of the Tropics and of Tertiary and Cretaceous coals, as well as the spores of Cretaceous and Carboniferous coals afford opportunities for researches of great botanical interest.

Erdtman's book is primarily a manual for botanists and contains chapters on the chemistry of peat by E. Erdtman, on field and laboratory methods for the collection and preservation of fresh and fossil pollen, on the identification of pollen and on methods of presenting an analysis. Important to botanists are six chapters devoted to the morphology and identification of pollen with elaborate references to the literature.

The discussion of the output and dissemination of pollen, the composition of pollen rains, the distance of transport and loss of pollen by decay is presented with ample references to the literature. Here is the heart of the subject, the area in which the greatest possible errors lie. Unfortunately the author is not so

critical, dispassionate or comprehensive as might be desired. To one acquainted with the subject, his remarks are perhaps adequate, but proof of the assumption that the pollen analysis represents with sufficient accuracy the pollen rain is not clear-cut and convincing. The errors of sampling and treatment of samples are not sufficiently differentiated from errors arising from the imperfections of the pollen record. Perhaps these matters are reserved for a later book on the stratigraphy and paleoclimatology of bogs. Indeed, it may not be possible to discuss all these matters in so brief a space. The absence of a truly critical discussion will leave those whose interest is paleoclimatological and chronological disappointed.

As a manual for the practicing pollen analyst or as a text-book for the aspiring student, the book will find its greatest usefulness. We can be grateful to the editor and his volunteer assistants for successful solution of the problems involved in publishing a text with the author isolated by the war. Errors seem to be at a minimum, but redrawing of some of the illustrations would have been helpful.

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SPECIAL ARTICLES

CORN GERM: A VALUABLE PROTEIN FOOD

In times of food stringency, such as are with us now and will stay with us until the havoc of war has subsided, the most economical use of available food supplies is imperative, and the introduction of new food materials should be welcome. Cowgill[1] has recently emphasized the importance of supplementing available foods by new or little-used foods, the nutritive value of which has been demonstrated by research precipitated by the war. This note calls attention to the value of corn germ as a potentially valuable protein food in human nutrition. The potential output of defatted corn germ, based on the crop yield of 1942, assuming a processing of 16 per cent. of the crop by dry milling and distilling,[2] and a yield of 7 per cent. of germ, has been estimated[3] at 1,000 million pounds per year.

The nutritive value of the proteins of the corn germ has not been studied by any method, in so far as the authors are aware. The potential availability of this food product in human nutrition warrants a better understanding of its nutritive properties. We therefore undertook a study of the digestibility and biological value of corn germ proteins, using the nitrogen balance method that has been developed in this laboratory.[4, 5]

The sample of defatted corn germ tested[6] was solvent-extracted at low temperatures (less than 75° C.) and analyzed as follows: 93.06 per cent. dry matter, 2.94 per cent. ether extract, 4.18 per cent. crude fiber, 21.19 per cent. protein ($N \times 6.25$), and 25.6 micrograms of thiamine per gram. The biological value of the protein in this product was measured with a group of 10 young albino rats with initial weights of about 70 grams, and was compared, by a reversal system of feeding, with that of the proteins of beef round, dried and defatted at a low temperature. Both test foods were incorporated in an otherwise complete diet in such amounts as to provide approximately 10 per cent. of protein ($N \times 6.25$), of which nutrient the test foods

TABLE 1

The Utilization of Nitrogen (Protein) in Defatted Corn Germ and in Autoclaved Soybeans, in Comparison with that of the Nitrogen of Beef Round

Utilization of corn germ nitrogen				
Rat No.	Coefficients of true digestibility		Biological value	
	Beef round	Defatted corn germ	Beef round	Defatted corn germ
229	100	87	77	84
231	100	84	77	78
233	100	82	74	83
235	100	87	72	80
237	99	79	73	66
230	100	90	77	80
232	100	77	86	79
234	99	87	79	79
236	99	89	77	72
238	100	88	77	75
Averages:	*99.7*	*85.0*	*76.9*	*77.6*

Utilization of soybean nitrogen				
Rat No.	Coefficients of true digestibility		Biological value	
	Beef round	Autoclaved soybeans	Beef round	Autoclaved soybeans
239	100	85	77	73
241	100	83	70	66
243	99	86	75	73
245	98	81	72	70
247	99	86	71	70
240	100	84	76	66
242	98	83	77	67
244	99	84	75	60
246	100	87	77	68
248	100	85	72	62
Averages:	*99.3*	*84.4*	*74.2*	*67.5*

[1] G. R. Cowgill, *American Scientist*, 31: 142, 1943.

[2] Corn germ made by the wet-milling process, due to leaching with water and contact with sulfurous acid, may not be highly valuable, either as a source of protein or of vitamins.

[3] This estimate was made by Ezra Levin, president of the VioBin Corporation, of Monticello, Ill., in a private communication.

[4] H. H. Mitchell, *Jour. Biol. Chem.*, 58: 873, 1924.

[5] H. H. Mitchell and G. G. Carman, *Jour. Biol. Chem.*, 68: 183, 1926.

[6] Obtained from the VioBin Corporation of Monticello, Ill., through the courtesy of Ezra Levin.

furnished practically all. In the first period, 5 rats received the corn germ diet while their pair mates received, in equal amounts, the beef diet. In the second period, all rats received the 4 per cent. egg protein (standardizing) diet, and in the third period the two diets were fed as in period 1, but to opposite pair mates. The results for true digestibility (corrected for metabolic nitrogen in the feces) and biological value (percentage of absorbed nitrogen retained for maintenance and growth) of the nitrogen in the two foods are summarized in Table 1.

It is evident from these data that the protein (nitrogen) of defatted (solvent-extracted at low temperature) corn germ is 85 per cent. as digestible as the protein of beef round, but that its biological value for the growing rat is as high as that of beef round.

The average biological value of 78 obtained for this sample of corn germ may be compared with values of 50 to 65 obtained for the cereal grains, 51 to 60 for a series of nuts widely used in the American diet, 72 for the cashew nut, 94 for whole egg, 90 for raw whole milk, and 62 to 77 for various cuts of meat and edible animal organs.[7] These values were all obtained in this laboratory by comparable methods.

A comparison of the utilization of the protein of corn germ with that of the soybean, a comparatively newcomer in the American diet, was also undertaken. The soybeans tested were dried, defatted and autoclaved at 17 pounds steam pressure for 1½ hours. The data presented in the right half of the table were obtained by an identical experimental procedure with beef protein as a reference food. From these figures, it is evident that soybean protein is about as digestible as corn germ protein, but that the digested protein is appreciably less available in satisfying the protein requirements of maintenance and growth.

Thus, corn germ prepared by dry milling is available in considerable quantities as a protein supplement to the American diet. It is a food rich in protein and also in thiamine. When processed in such manner as to preserve its inherent nutritive properties, its protein is well digested, and after digestion it is as well utilized in satisfying the protein requirements of the body as is the protein of the best cuts of meat. In the difficult times ahead, with food shortage at hand or in immediate prospect, and a protein shortage a distinct possibility, a full utilization for human needs of the corn germ already available as a by-product of the corn milling industry would seem to be a wise eventuality. Furthermore, the withdrawal of corn germ from the corn milling by-products used as animal feeds would not precipitate a serious situation in livestock feeding because the protein thus withdrawn can be amply replaced from sources unfit for human consumption or less well utilized by the human, while the withdrawal of its thiamine is of no significance to animals living so largely on whole grains or forages.

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[7] H. H. Mitchell, *Proc. Seventh Convention of the Royal Academy of Italy, Rome*, 1937, p. 101.

CONTROL OF AIR-BORNE MICROORGANISMS BY ULTRAVIOLET FLOOR IRRADIATION

Studies of air-borne bacteria in living spaces have demonstrated that bacterial counts are correlated with human activity and that the highest number of bacterial colonies are recovered in the lower levels of such spaces. There are also reports that cross infections can be reduced to a measurable extent by prohibiting the making of beds immediately before dressings are to be changed and by carefully oiling floors and avoiding dry sweeping. It has long been known that pathogenic microorganisms can be recovered from the dust of rooms where carriers of such organisms are present.[1, 2, 3]

From these facts it may be inferred that bacteria of the air are closely associated with dust particles on floors and lint and dust attached to blankets, linens and clothes. During periods of human activity the momentary turbulence of the air raises dust which quickly subsides after the room is emptied or activity is reduced.

Because of these considerations it was thought that ultraviolet floor irradiation might be more effective in controlling air-borne bacteria than upper-air irradiation or that the two in conjunction might be more effective than the present practice of merely irradiating the upper third of rooms or wards.[4]

To check the effectiveness of ultraviolet floor irradiation several experiments were conducted in a sheet-metal-covered experimental chamber of 9 × 7 × 8 feet. The floor of this room was irradiated by 4 eight-watt low pressure mercury vapor glass lamps, 30 inches from the floor. All radiation from the lamps was reflected downwards. One half hour before each experiment a small amount of fine house dust was introduced into the experimental chamber. Two small fans were placed in opposite corners of the room. The fans were maintained at a constant speed throughout all tests.

Bacteria in the air were quantitated by the open

[1] E. White, *Lancet*, 1: 941, 1936.
[2] J. C. Thomas, *Lancet*, 1: 433, 1941.
[3] M. VanDenEnde and C. H. Andrewes, "Aerobiology," Am. Asn. Adv. Science, Misc. Publ. 17, 1942.
[4] W. F. Wells and M. W. Wells, "Aerobiology," Am. Asn. Adv. Science, Misc. Publ. 17, 1942.

plate method, the bubbler pump[5] and by the funnel device.[6] In each experiment four sets of samples were taken at 30-minute intervals. The effect of ultraviolet radiation was determined by starting the lamps after the second set of samples had been taken. As a control two sets of experiments were performed without lighting the lamps so as to estimate the effect of settling without radiation.

TABLE 1

THE EFFECT OF ULTRAVIOLET FLOOR IRRADIATION WITH FOUR ULTRAVIOLET LAMPS ON AIR-BORNE BACTERIA. LIGHTS ON 10 TO 20 MINUTES AFTER THE SECOND RUN. TIME BETWEEN RUNS ABOUT 30 MINUTES. TEMPERATURE: 31–35° C. RELATIVE HUMIDITY: 53–63 PER CENT. ADDITIONAL FIVE EXPERIMENTS WITH LIGHTS ON AND OFF AND ONE ADDITIONAL CONTROL GAVE SIMILAR RESULTS TO THE ABOVE EXPERIMENTS

		Experiment 1						Control					
		Run	No. of observ.	Mean per plate	σ	No/10 c. ft.		Run	No. of observ.	Mean per plate	σ	No/10 c. ft.
Open plate	Lights off	1	10	20.3	2.04	...	Lights off	1	10	20.8	5.40	...
		2	10	21.1	1.83	...		2	10	17.5	4.45	...
	Lights on	1	10	4.5	1.25	...		3	10	20.5	8.20	...
		2	10	5.4	2.04	...		4	10	23.2	2.85	...
Bubbler pump	Lights off	1	12	4.8	.73	242	Lights off	1	12	4.5	1.32	225
		2	12	4.2	.74	210		2	12	4.3	.96	217
	Lights on	1	12	1.3	.38	63		3	12	3.3	.70	169
		2	12	1.9	.44	96		4	12	4.1	1.19	204
Funnel device	Lights off	1	2	49	...	49	Lights off	1	2	59	...	59
		2	2	43	...	43		2	2	50	...	50
	Lights on	1	2	29	...	29		3	2	47	...	47
		2	2	16	...	16		4	2	46	...	46

The results of these various runs are shown in Table 1. It will be observed that the ultraviolet floor irradiation produced a significant lowering of air-borne bacteria in the experimental chamber.[7]

The results are sufficiently striking to justify the suggestion that floor irradiation be combined with ceiling irradiation in practical tests in barracks or hospital wards to determine the effect, if any, of ultraviolet irradiation in lowering morbidity rates or preventing cross infection. If such experiments be attempted it must be borne in mind that certain types of flooring may prove to be capable of reflecting sufficient amounts of ultraviolet to cause harmful effects.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

SPECTROSCOPIC MICRODETERMINATION OF MUSCLE ADENYLIC ACID

THE absorption spectrum of adenylic acid in the ultraviolet shows a maximum at 2,600 Å, which is characteristic for the adenine group.[1] The deaminated product inosinic acid has its absorption maximum at 2,500 Å. This difference in absorption spectra between the amino and the hydroxy purine nucleotides was described as early as 1932 by Myrbäck, Euler and Hellström[2] and recently a corresponding difference in absorption spectra has been described for adenine and hypoxanthine.[3] Adenylic acid has a much higher absorption than inosinic acid in the range: 2,700–2,600 Å. At 2,650 the absorption of inosinic acid is only 40 per cent. of that of adenylic acid (see Fig. 1). This great difference in absorption spectra has been used in the present studies as a basis for a very sensitive and specific test for Schmidt's deaminase[4] or for identification and quantitative de-

[5] S. M. Wheeler, G. E. Foley and T. Duckett Jones, SCIENCE, 94: 445, 1941.

[6] Alexander Hollaender and J. M. Dalla Valle, *U. S. Public Health Reports*, 54: 574, 1939.

[7] A difference of three times the σ of the series between bacterial counts with lights on and off was considered as a criterion of significance.

[1] Ch. Dhere, *C. R. Soc. Biol., Paris*, 60: 34, 1906.

* The opinions advanced in this paper are those of the writers and do not represent the official views of the Navy Department.

[2] K. Myrbäck, H. Euler and H. Hellström, *Zs. physiol. Chem.*, 245: 65, 1932.

[3] M. M. Stimson and M. A. Reuter, *Jour. Am. Chem. Soc.*, 65: 153, 1943.

[4] G. Schmidt, *Zs. physiol. Chem.*, 179: 243, 1928.

termination of muscle adenylic acid (adenosine-5-phosphate). If a few micrograms of Schmidt's deaminase are added to a solution of adenylic acid and the absorption at 2,650 Å is determined in the Beckmann spectrophotometer one observes a steady decrease in absorption, proportional to time within the first few minutes, decreasing in rate later. The absorption decreases to less than half (45 per cent.) of the original but seems to come to a standstill before complete deamination has been reached. It has not so far been possible to observe any amination of inosinic acid with ammonia salts.

The deaminase test is performed in the following way. To 10 or 15 μ g adenylic acid per ml (5×10^{-5} M) containing 0.05 M succinate buffer pH 5.9 is added to 2 to 5 μ g of Schmidt's deaminase, purified through isoelectric precipitation and ammonium sulphate fractionation. The deamination takes place in a quartz vessel, 1 cm in depth, which is exposed to ultraviolet light of the wavelength 2,650 Å. The deamination causes a fall in the absorption and the decrease is read every minute on the absorption scale of the Beckmann spectrophotometer. A measurement of the absorption in the range from 2,400 to 2,800 Å before and after addition of deaminase shows the spectra of adenylic acid and inosinic acid (with traces of adenylic acid) respectively (Fig. 1). A decrease in absorption

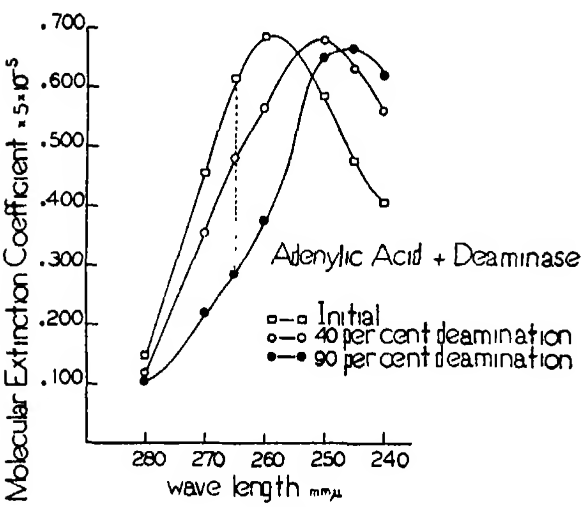

FIG. 1.

at 2,650 Å corresponding to less than 10 per cent. of complete reaction is readily detectable. If the adenylic acid concentration is $5 \times^{-5}$ M, a 10 per cent. decrease corresponds to a liberation of 0.07 μ g N.

The formation of adenylic acid when myokinase[5,6] is added to adenosine diphosphate (2 adenosine diphosphate ⇄ adenosine triphosphate + adenylic acid) can be also demonstrated in the micro test. Addition of purified deaminase to a 5×10^{-5} M solution of adenosine diphosphate (pH 6.2) does not give rise to any change in the absorption at 2,650 Å. If now a few micrograms of myokinase are added the absorption decreases proportionally with the amount of added myokinase, provided deaminase is in excess. Between 40 and 45 per cent. of the adenosine diphosphate is converted to inosinic acid, indicating that more than 80 per cent. of the adenosine diphosphate has been converted into the tri- and monophospho-nucleosides.

The spectrophotometric myokinase test requires one to two μ g pyrophosphate P (as adenosine diphosphate) where the hexokinase test requires 20 to 50 μ g pyrophosphate P. On the other hand, in the spectrophotometric test both the deaminase and the myokinase act outside their pH optima. The deaminase has a sharp pH optimum at 5.9[4] the myokinase a broad optimum between pH 7 and 7.5[6] and neither of the enzymes has any appreciable activity at the pH optimum of the other. At pH 6.2–6.5 both enzymes exhibit a fairly high although not optimal activity.

The *deaminase preparations* show a slight effect on adenosine. However, adenosine is deaminated 60 times slower than adenylic acid.

Adenylic acid from yeast nucleic acid is not deaminated by the deaminase (*cf.* footnote 4), a fact which in 1928 led Embden and Schmidt[7] to the differentiation between muscle adenylic acid (adenosine-5-monophosphate) and nucleic acid adenylic acid (adenosine-3-monophosphate).

Thus, the method is specific for muscle adenylic acid (and diadenylic acid[8]). Methods based on adenylic acid as a phosphate transfer system[9] are specific for adenosine-5-phosphate derivatives but can not distinguish between adenylic and adenosine diphosphate. The micromethod presented here does distinguish between adenylic acid and adenosine diphosphate due to a separation of the deaminase from myokinase.[6]

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[5] S. P. Colowick and H. M. Kalckar, *Jour. Biol. Chem.*, 148: 117, 1943.

[6] H. M. Kalckar, *Jour. Biol. Chem.*, 148: 127, 1943.

[7] G. Embden and G. Schmidt, *Zs. physiol. Chem.*, 181: 130, 1929.

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GALACTIC EVIDENCES FOR THE TIME-SCALE OF THE UNIVERSE[1]

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An important phase of modern astronomical research is concerned with the time scale of the universe, *i.e.*, with the specification of a natural unit of time in which it would be most convenient to describe the changing aspects of the astronomical universe. Stated in this manner, it is apparent that the solution to the problem of the time scale will not permit us (not at any rate in the first instance) either to "date" the present epoch in a "fundamental" calendar or to forecast with definiteness the "end." What it would allow us, however, is to specify an interval of time in which various aspects of the astronomical universe may be expected to change appreciably. Conversely, the solution to the problem of the time scale will ultimately depend on the study of a variety of different aspects of the universe and the establishment in each case of a time interval during which the aspect studied might change to an appreciable extent. And if such studies should lead us in most instances to time intervals which are of the same order of magnitude, it would not be unreasonable to attribute to a unit of time of this order of magnitude a fundamental significance. It would appear that this is the only manner in which a rational approach to the problem of the time scale can be made. However, in formulating the problem in this manner it is evident that a certain element of arbitrariness has been introduced into the discussion. But this is unavoidable and inherent in a problem in which the emphasis is on an order of magnitude and not on an absolute measure.

During the past twenty years many attempts have been made to establish a time scale in the sense de-

[1] Address given before the Philosophical Society of Washington on December 4, 1943.

scribed above.[2] But several of the arguments were inconclusive and in some cases even left room for violent disagreements. However, more recently, through the study of the dynamics of star clusters and the statistics of binary stars, some fresh evidences have come to light which bear on the question of the time scale. And it is the object of this report to describe the nature of these newer evidences.

To consider first the problem presented by galactic star clusters we shall take a concrete example and consider the case of the Pleiades. This star cluster includes some 200 stars in a spherical volume of radius about 3 parsecs (*i.e.*, approximately 10 light years). Moreover, a study of the internal motions in this cluster (made possible by some photographic plates of this cluster taken by Rutherford as early as 1870) has revealed that relative to the center of gravity the cluster members have a random motion with a root mean square velocity in the neighborhood of 500 meters per second. Since the average space density of stars in the general neighborhood of the sun is only about one star per ten cubic parsecs, it follows that in the Pleiades the star density is about twenty times that of the background "field" stars. Further, these field stars have motions relative to the center of gravity of the cluster of the order of 25 to 30 kilometers per second. Accordingly, it would appear that the Pleiades can be considered as an "isolated" stellar system, *i.e.*, practically uninfluenced by the field stars. And the question arises as to the permanence of such stellar aggregations. In order to answer this question we need to go into the dynamics of star clusters, and as this theory appears to have some general interest we may be allowed to elaborate on it a little.

First of all, it is evident that the gravitational force acting on a star is subject to fluctuations. The fluctuations arise simply as a consequence of the relative motions between the stars and the consequent changing complexion of the distribution of stars around any given one. In a general way it is clear that there will be practically no correlation in the forces (due to the near neighbors) acting on a star at two instants separated by an interval of the order required for an average star to traverse a distance equal to the average distance between the stars. For in this interval of time the complexion of stars around any given one may be expected to change radically. Now we may ask as to the effect of this fluctuating force on the motion of a star. In order to answer this question consider an interval of time of the order of a million years. During such an interval a star would have experienced some hundred elementary fluctuations, and a theoretical analysis shows[3] that the cumulative effect of such a large number of fluctuations has a two-fold consequence. First, it systematically decelerates the star in the direction of its motion and, second, superposes on this a random acceleration. More precisely, if we consider a time interval Δt long compared with the elementary fluctuations (but not so long that the increment in the velocity which the star may be expected to suffer is comparable with its initial velocity) then in the direction of its motion it will experience, on the average, a deceleration proportional to Δt. And the constant of proportionality, which may very well and, in fact, does depend on the magnitude of the initial velocity, may properly be called the *coefficient of dynamical friction:* it is dynamical because it operates only on stars in motion and it is friction because it acts as a brake on the motion of the star. Regarding the random part, it may be said that in consequence of this the mean *square* acceleration which the star may be expected to experience during a time Δt will also be proportional to Δt: the constant of proportionality which occurs here is sometimes called (for reasons which we shall not go into) the *coefficient of diffusion* in the velocity space.[4] The existence of these two terms in the acceleration experienced by a star may sound somewhat paradoxical. But it can be readily shown that these two terms (together with the relation which exists between them) are both necessary and sufficient for the maintenance of statistical equilibrium.

It will be noticed that the foregoing description of the effect of the fluctuating gravitational field on the motion of a star is very similar to the influence of the molecules of the surrounding liquid on the motion of suspended colloidal particles in the theory of the Brownian movement. Thus, in the latter theory, it is assumed that the colloidal particles experience both a dynamical friction (now given by Stokes's law) and a random acceleration (related in fact with Stokes's frictional coefficient in a definite manner). There is, however, one important difference: in the stellar case stars influence each other, while in Brownian motion the colloidal particles are influenced only by the molecules of the surrounding fluid. But physically, the close analogy that exists between the motion of a star in the fluctuating gravitational field of its neighbors and the motion of a colloidal particle describing Brownian motion results from the following circumstance: Even as the collision with a single molecule of the surrounding liquid hardly affects the motion of a colloidal particle, so also does an elementary fluctuation in the force due to the neighbors hardly affect

[2] For a comprehensive account of these attempts see H. N. Russell, SCIENCE, 92: 19, 1940.

[3] The interested reader may refer to S. Chandrasekhar, *Astrophysical Journal*, 97: 255–262, 1943.

[4] It can further be shown that the ratio of the diffusion coefficient to the frictional coefficient is a constant of the system.

the motion of a star; and in both cases what is of importance is the cumulative effect of a large number of separate events, each having only a very minute effect.

Having described the manner in which the motion of a star is influenced by a fluctuating force acting on it, it is evident that we should, in principle, be able to calculate the probability with which a star initially having a given velocity will acquire (for the *first time*) some other preassigned velocity at some specified later time. And if a star should acquire in this manner a velocity sufficient to escape from the entire gravitational attraction of the cluster altogether, then we should have calculated the probability that the star would escape from the cluster at the specified later time. In other words, we have here a rational means for estimating the rate at which stars may be expected to escape from a cluster and thus an estimate of the rate at which clusters tend to disintegrate. On carrying through the necessary calculations[5] it is found that we can express the probability that a star would have escaped from the cluster during a time t in the form

$$1 - e^{-t/t_0} \tag{1}$$

where t_0 is a certain time related in a definite way to the physical parameters of the cluster (*e.g.*, its radius, star density, etc.). According to the foregoing formula, in a time equal to t_0 the probability that a star would have escaped from the cluster amounts to as much as 0.63. Accordingly, t_0 may be taken as a measure of the average life of the cluster. For the Pleiades it is found that t_0 is about 3×10^9 years. Since, however, the Pleiades are in no way exceptional as a galactic cluster it may be concluded that galactic clusters in general have mean lives of this order. On the other hand, galactic clusters appear to be an essential feature of the Milky Way system. It would, therefore, appear that the existence of galactic clusters like the Pleiades would point to a time scale for the galaxy of the order of 3×10^9 years. This is the first of the two major galactic evidences to which we referred at the outset. We now turn our attention to the second evidence.

As is well known, a very substantial fraction of all the stars occur as components of multiple stars. And by far the most important among these multiple stars are the binaries. We shall now indicate how from a study of the statistics of binary stars,[6] *i.e.*, from a study of the frequencies of occurrence of the various parameters of the binary such as its period, eccentricity, the semi-major axis of the relative orbit, etc., we can draw some conclusions bearing on the question of the time scale. As in the case of galactic clusters the basis for the discussion is again provided by considerations relating to stability. However, while the "instability" of the clusters arose from the possibility of its members accidentally acquiring under the influence of the other cluster members velocities sufficient to escape from the cluster, in the case of binaries the tendency towards disruption is caused by the tidal effects of the nearby stars. For, the distances of the neighboring stars from the two components of the binary, respectively, will be different; consequently, the net forces acting on the two components will also differ. For the separations between the components normally encountered, and which are of practical interest, this difference in the forces acting on the two components will in general be only very slight. But it is precisely this difference operating over sufficient lengths of time that will cause the eventual dissolution of a binary. Without going into the details of the calculation[7] it may be stated that under the conditions prevailing in the general neighborhood of the sun in the Milky Way, the time of dissolution of a binary can be expressed as

$$\tau = 2.2 \times 10^{15} a^{-3/2} \text{ years} \tag{2}$$

where a denotes the semi-major axis of the relative orbit in astronomical units ($= 1.5 \times 10^8$ km). The meaning of the foregoing formula is simply that in a time τ the tidal effect of the neighboring stars is sufficient to accelerate one component of the binary relative to the other by an amount which will make the kinetic energy of relative motion of the two components exceed the gravitational binding energy between them. And now, according to formula (2), binaries with separations between 1,000 and 10,000 astronomical units will be "dissociated" in times ranging from 7×10^{10} to 2×10^9 years. This result can be reinterpreted as follows: Suppose we consider an interval of time of 10^{10} years. Then during such an interval the dynamical elements of binary orbits with semi-major axes between 1,000 and 10,000 astronomical units will have suffered substantial changes. In other words, for these binaries the distribution over the different parameters must (in course of 10^{10} years) tend towards what should be expected under conditions of statistical equilibrium. But it has been shown by V. A. Ambarzumian[8] that the observed distribution of the separations among the binaries, in the range 1000–10,000 astronomical units, is such that those with the larger separations occur with far less frequency than should be expected under conditions approximating those of equilibrium. Accordingly, we should

[5] For the details see S. Chandrasekhar, *Astrophysical Journal*, 98: 54–60, 1943.

[6] The most recent of such statistical studies is that due to G. P. Kuiper, *Astrophysical Journal*, 95: 201, 1942.

[7] For these see a forthcoming paper in the *Astrophysical Journal*.

[8] *Russian Astronomical Journal*, 14: 207, 1937; also *Nature*, 137: 537, 1936.

conclude that sufficient time has not elapsed for the tidal forces of the neighboring stars to appreciably modify the elements of binary orbits with separations in the range stated. This implies that 10^{10} years represents a true upper limit to the time scale, and would suggest a time scale of the order of, say, 5×10^9 years.

The discussion of the mean lives of galactic clusters and the statistics of binary stars agree therefore in pointing to a time scale of the order of a few billion years. We may now briefly summarize the other evidences which also point to a similar time scale. First, we have the geochemical evidence derived principally from the lead content of minerals containing uranium salts and leading to the ages of the igneous rocks containing these minerals. In our present context most interest is naturally attached to those determinations which lead to the greatest ages. Thus, the analysis of a pegmatite in Manitoba containing uranite, monozite and mica leads to three independent determinations of age ranging from 1,600 to 1,900 millions of years. We may say then that a billion and a half years represents a true lower limit to the age of the earth. An upper limit can also be found (as was first indicated by H. N. Russell) from the entire lead content of the earth's crust on the assumption that all of it has been derived as the end products of radioactive disintegrations. In this manner an upper limit of three and a half billion years has been estimated. In other words, the age of the earth has been bracketed between one and a half and three and a half billions of years. Similar ages have also been found for the meteorites from their helium content.

Still another evidence for the time scale comes from the velocity interpretation of the "red shift" shown by the extra-galactic nebulae and the velocity-distance relationship of Hubble. As is well known, this relationship can be interpreted as meaning that some two billion years ago all the nebulae were confined to a relatively very small volume and that they were projected with their present speeds in their present directions. It is, of course, possible that the velocities of the nebulae were different at earlier epochs, but the interpretation given is probably adequate for drawing inferences concerning the time scale.

Finally, we may also draw attention to the information that can be derived from clusters of extragalactic nebulae such as the Coma and the Virgo clusters. The Virgo cluster, for example, includes some 400 nebulae in a spherical volume of about 200,000 parsecs radius. It is not certain that the Newtonian laws of gravitation can be applied to objects of this size. But we can probably apply the theory which we have described for the galactic star clusters to the clusters of nebulae to obtain very rough estimates. In this manner Miss Tuberg[9] has recently estimated for the Virgo cluster a mean life of the order of 10^{11} years.

To conclude, then, we see that the geochemical evidence bearing on the age of the earth and meteorites, the galactic star clusters, the statistics of binary stars, the clusters of extragalactic nebulae and finally the system of the nebulae, all agree in pointing to a time scale of the order of a few billion years. It does not seem that this can be accidental.

[9] *Astrophysical Journal*, 98: 501, 1943.

SOVIET STUDIES ON VIRUSES[1]

By Dr. W. M. STANLEY

THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH, PRINCETON, N. J.

ON February 12 in 1892 a young man, Dmitrii Iwanowski, appeared before the Academy of Science at St. Petersburg and presented his second scientific contribution, a short four-page paper entitled "On the Mosaic Disease of the Tobacco Plant."[2] Most of this short paper was devoted to an innocuous discussion of the symptomatology of the disease as he had observed it in the Crimea, and it is only near the end that there was given a one-sentence description of an experiment which has come to be recognized as a landmark in medical history. This sentence goes as follows: "Yet I have found that the sap of leaves attacked by the mosaic disease retains its infectious qualities even after filtration through Chamberland filter-candles." This filtration experiment by Iwanowski led to the discovery of viruses, which we now recognize as a large group of infectious agents, smaller than ordinary living organisms, that may cause disease in man, animals, plants and bacteria. To this group belong the agents responsible for such diseases as smallpox, yellow fever, poliomyelitis, influenza, the virus pneumonias of man, horse encephalomyelitis, foot-and-mouth disease of cattle, hog cholera, rabies, dog distemper, fowl pox, certain types of tumorous growths in fowls and other animals, jaundice of silk-worms, various yellows and mosaic diseases of plants and

[1] Address at the Science Panel of the Congress of American-Soviet Friendship, New York, November 7, 1943. The complete proceedings of the Science Congress including the Medical Session will be published at a later date by the National Council of American-Soviet Friendship.

[2] D. Iwanowski, *Bull. Acad. Imp. Sci. St. Petersburg*, 3: 67, 1892.

the transmissible lysis of bacteria. Although vaccination as a means of protection against smallpox was in use long before the recognition of the existence of viruses and notable success in the prevention of yellow fever and encephalomyelitis has been achieved recently by vaccination with mild virus strains or with inactivated virus, there remain many important diseases, such as the virus pneumonias, influenza, poliomyelitis and several afflictions of animals and plants, for which there now exists no acceptable means of protection of whole populations. The newer wonder materials, such as the sulfa drugs and penicillin, generally have not been found to be effective in the treatment of virus diseases. From a medical standpoint, therefore, the viruses have come to represent a most important group of infectious disease-producing agents.

Iwanowski was certainly unaware of the great importance and significance of the filtration experiment which he described in 1892. He regarded the mosaic disease as bacterial in nature and suggested that his unusual results might be due to a defect in the filter candle or to the presence of a bacterial toxin. However, six years later Beijerinck confirmed Iwanowski's filtration results and proved by serial passage of the filtrate that the infectivity was due to a filterable agent and not to a bacterial toxin.[3] Beijerinck referred to the active agent as a "contagious living fluid" and appeared to believe that it was not bacterial in nature but was an unorganized entity. The same year, Loeffler and Frosch reported that the foot-and-mouth disease of cattle was due to a virus,[4] and in 1901 yellow fever was found by Reed and co-workers to be a virus disease of man.[5] It is not surprising that Iwanowski failed to grasp immediately the full significance of his 1892 filtration experiments, for the results were directly contrary to all accepted scientific knowledge. However, when similar results were obtained with diseases of man and animals, he seemed to have recognized the challenge which was presented and immediately set about to learn something of the nature of tobacco mosaic virus. He reported his extensive experiments on this virus in a 40-page paper published in 1903.[6] The nature of the experiments which he conducted and the manner in which they were carried out and discussed serve to mark Iwanowski as a most able investigator. He was aware that tobacco mosaic virus represented the first of a new kind of infectious disease-producing agent, and he recognized fully the great difficulty in describing exactly the nature of an agent that could pass a Chamberland filter but not a dialysis membrane and one which could reproduce only within living cells and not on artificial media. The ideas that he expressed are quite similar to those held to-day by many leading virus workers. Iwanowski's 1903 paper is also notable for his accurate description of the intracellular inclusions in the cells of mosaic-diseased plants. His description of the needle crystals formed within diseased cells upon the addition of acid is of interest, for in the light of present-day knowledge it seems likely that this material was crystalline tobacco mosaic virus. Iwanowski's claim to fame has grown with the years and, although his life has not been treated biographically and even the place of his birth and early training appear to be unrecorded in the scientific literature, I believe that his relationship to viruses should be viewed in much the same light as we view Pasteur's and Koch's relationship to bacteriology. There is considerable justification for regarding Iwanowski as the father of the new science of virology, a field of endeavor which to-day is of great importance not only in medicine but in several closely allied fields of study.

For over thirty years, studies on viruses were at a low ebb in Russia as well as in other countries. Most of the work consisted of the description of new virus diseases, of the pathology involved therein and of the ways by means of which viruses are transmitted from host to host. However, the coming importance of plant viruses was recognized by Rischkov, then professor of plant pathology at Charkow, who in 1935 published a book entitled "Virus Diseases of Plants."[7] The isolation in this country in 1935 of tobacco mosaic virus in the form of a crystalline nucleoprotein of high molecular weight[8] was immediately recognized in Russia as providing a new approach to the study of viruses. This finding was soon repeated and confirmed by Rischkov at the Microbiological Institute in Moscow.[9] In 1937 and again in 1938 Rischkov published reviews in the Russian language of the extensive work which had been carried out in this country and in England on purified virus preparations.[10,11] In 1938 he published with Gromyko a description of a new method for the purification of tobacco mosaic virus.[12] Rischkov also demonstrated with Soukhov the important fact that crystalline tobacco mosaic virus possesses no enzymatic activity other than that of virus activity.[13] Goldin, working at the Microbiological

[3] M. W. Beijerinck, *Verh. Akad. Wetensch., Amsterdam, II, no. 5,* 6: 1, 1898.

[4] F. Loeffler and P. Frosch, *Zentralbl. Bakt., I, Orig.,* 28: 371, 1898.

[5] W. Reed, J. Carroll, A. Agramonte and J. Lazear, see *Senate Documents,* 66(822): 156, 1911.

[6] D. Iwanowski, *Zeitschr. Pflanzenkr.,* 13: 1, 1903.

[7] V. L. Rischkov, "Virus Diseases of Plants," Moscow, 1935.

[8] W. M. Stanley, Science, 81: 644, 1935.

[9] V. L. Rischkov, Private communication.

[10] *Idem, Microbiologiia,* 6(6): 830, 1937.

[11] *Idem, Progress of Contemporary Biology U.S.S.R.,* 9: 351, 1938.

[12] V. L. Rischkov and E. P. Gromyko, *Compt. rend. acad. sci. U.R.S.S.,* 19: 203, 1938.

Institute in Moscow, reported that putrefactive bacteria do not decompose crystalline tobacco mosaic virus and that virus may be adsorbed by various microorganisms.[14] Goldin also published a paper on "Some Data Concerning Crystalline Inclusions in the Mosaic Virus Disease of Tobacco," in which he called attention to the similarity between the properties of crystalline tobacco mosaic virus and those of the crystalline material described by Iwanowski in 1903.[15] The effect of ether on bacteriophages and tobacco mosaic virus was studied by Goldin, who found neither agent to be soluble in ether.[16]

In addition to the work that I have described, Russian investigators have made studies of a practical nature on several virus diseases, chiefly of virus diseases of cereal crops. Studies of importance have also been made on virus diseases of man and animals. For example, in 1937 Smorodintseff and coworkers reported the results of a study in which volunteers were inoculated experimentally with influenza virus[17] and in 1940 an investigation was described in which biweekly inhalations of vaporized influenza antiserum were given to a large number of persons before and during an influenza epidemic.[18] These two methods of approach to the influenza problem have subsequently been employed by American workers. It should perhaps be noted that the inhalation of antiserum has yielded the most favorable results yet reported in connection with the prevention of influenza in man. The war does not appear to have interfered seriously with virus studies in Russia, for in a paper in last month's *Phytopathology* entitled "The Nature of Ultra-Viruses and Their Biological Activity," Rischkov[19] mentions a conference on plant virus diseases which was held in Moscow in 1941 and describes researches which were reported at a meeting of the Ukrainian Academy of Sciences in January, 1942. In 1942 a number of the Russian journal *Microbiology*[20] was issued in celebration of the fiftieth anniversary of Iwanowski's filtration experiment with tobacco mosaic virus. In the introductory article Koshtoiants[21] not only describes and evaluates Iwanowski's early findings but also much of the contemporary work on viruses. The author's defense of the importance of Russian science and the occasional indulgence in polemics appear unnecessary. The important researches of Engelhardt and Ljubimowa on the enzyme activity of myosin, of Rischkov on plant viruses, of Graschenkoff on encephalitis, of Petroff on tumors, of Gamali on immunity and of Smorodintseff on influenza are mentioned with justifiable pride. In the second paper Rischkov[22] discusses the origin of viruses and in two succeeding articles Suchov[23] and Vovk[24] describe some recent work on plant viruses.

Let us all hope that it will not be long before the rich promises of Iwanowski's early work on viruses will be even more fully realized in Soviet Russia.

OBITUARY

RECENT DEATHS

ARTHUR KEITH, from 1894 until his retirement in 1934 geologist of the U. S. Geological Survey, died on February 7 at the age of eighty-one years.

DR. BERNARD SACHS, formerly professor of clinical neurology at the College of Physicians and Surgeons of Columbia University and director of the division of child neurology at the Neurological Institute, died on February 8 at the age of eighty-six years.

DR. ARTHUR RENWICK MIDDLETON, since 1939 emeritus professor of inorganic chemistry at Purdue University, a member of the faculty for forty years, died on February 6 in his seventy-fifth year.

DR. DAVID ELDRIDGE WORRALL, professor of organic chemistry and director of the chemical laboratory at Tufts College, died on February 7. He was fifty-seven years old.

SCIENTIFIC EVENTS

THE POLISH FACULTY OF MEDICINE AT EDINBURGH UNIVERSITY

A CORRESPONDENT of the *Journal* of the American Medical Association writes: "The only existing scientific institution with university standing which a great European nation has maintained is the Polish School of Medicine in the University of Edinburgh. It is unique in the fact that never before has any state set

[13] V. L. Rischkov and K. S. Soukhov, *Compt. rend. acad. sci. U.R.S.S.*, 21: 265, 1938.

[14] M. I. Goldin, *Compt. rend. acad. sci. U.R.S.S.*, 20: 735, 1938.

[15] *Idem*, *Microbiology U.S.S.R.*, 7: 353, 1938.

[16] *Idem*, *Bull. Acad. Sci. U.R.S.S.*, 173, 1938.

[17] A. A. Smorodintseff, M. D. Tushinsky, A. L. Drobyshevskaya, A. A. Korovin and A. I. Osetroff, *Am. Jour. Med. Sci.*, 194: 159, 1937.

[18] A. A. Smorodintseff, A. G. Gulamow and O. M. Tschalkina, *Zeitschr. klin. Med.*, 138: 756, 1940.

[19] V. L. Rischkov, *Phytopathology*, 33: 950, 1943.

[20] The writer is especially indebted to Dr. S. A. Waksman of Rutgers University for providing this number of *Microbiology* (Vol. 11, No. 4, 1942) and to Dr. M. Kunitz of the Rockefeller Institute for assistance in reading two of the articles.

[21] C. S. Koshtoiants, *Microbiology U.S.S.R.*, 11: 139, 1942.

[22] V. L. Rischkov, *Microbiology U.S.S.R.*, 11: 149, 1942.

[23] K. S. Suchov, *Microbiology U.S.S.R.*, 11: 168, 1942.

[24] A. M. Vovk, *Microbiology U.S.S.R.*, 11: 177, 1942.

up its own university with its own professors lecturing to its own students in their native tongue on foreign soil as part of a foreign university. After the collapse of France in June, 1940, many Polish medical officers escaped and collected in one of the Polish army camps in Scotland. Among them were several professors, lecturers and specialists of high standing whose knowledge and experience could not be used in the early stages of the reorganization of the Polish army on British soil. Lieutenant Colonel F. A. E. Crew, commanding the Scottish Military Hospital, was one of the first to realize the needs of Poland, and in October, 1940, initiated the scheme which led to the creation of the Polish Faculty of Medicine within the University of Edinburgh.

"Professor Antoni Jurasz, dean of the Polish Medical School, has stated in a press interview that the Poles in Britain were eager to welcome any scheme which would ensure close collaboration of the universities and scientific worlds of the two countries after the war. There has been an increasing response from the Poles in Great Britain to the establishment of the medical school. The total for the current year was 200 students, and the total number of doctors graduated from the Polish Medical School is fifty-three. The training of undergraduates and newly qualified doctors is carried on in the Padereweski Hospital, which is devoted entirely to the care of Poles in Britain. This hospital was established mainly through the foresight of an American, Mrs. Charlotte Hoffman Kellogg, president of the Padereweski Testimonial Fund, which has provided equipment and individual help to needy students from the Middle East. The physicians at the hospital are all Polish, the heads of the departments being professors or lecturers at the university. There are at present 116 beds, of which two thirds are for medical and the remainder for surgical cases."

THE REFRIGERATION RESEARCH FOUNDATION

THE Refrigeration Research Foundation, a non-profit-making corporation, was organized under Illinois laws on October 14, 1943. It is composed of two groups—public members who have achieved civic distinction, and sustaining members, representatives of companies who have contributed funds to the program of the foundation. It will begin its work with an initial fund of $250,000, which will be expended in grants for research to be carried on in the laboratories of already established colleges, universities and technological institutions. The funds will be provided by subscriptions from corporations, firms or individuals engaged in the preservation of food or other commodities by refrigeration. Research will be carried on in Canada and Mexico as well as in the United States. Its objects are:

To improve the methods of refrigeration for the better preservation of food and other commodities essential to the health and welfare of the American people.

To develop and support research in the science and art of refrigeration of food and other commodities through a nationwide program of financial grants to established institutions and agencies of research.

To establish fellowships in institutions and agencies of research and thereby to aid in the training of competent personnel to give activation and leadership to the refrigeration of commodities essential to the national economy.

To establish in the interest of the American people a repository of scientific information relating to the refrigeration of food and other materials.

To cooperate with and aid agencies of Federal and State governments, institutions of research and others in connection with their scientific and educational work involving the refrigeration of food and other products.

The foundation will not engage in any business or activity customarily performed for profit nor will it engage in any political activity or carry on propaganda or attempt to influence legislation.

The president of the foundation is Roy M. Hagen, of Los Angeles; the director of the scientific program is H. C. Diehl, principal chemist and chief of the commodity processing division of the Western Regional Research Laboratory of the U. S. Department of Agriculture. Dr. Samuel C. Prescott, who until 1942 was dean of science at the Massachusetts Institute of Technology, now emeritus professor of biology, was elected chairman of the Board of Governors to serve until the first annual meeting. At that meeting he was appointed director of the institute. His headquarters will be at Berkeley, Calif.

THE INSTITUTE OF AVIATION PSYCHOLOGY

A RESEARCH institute on "aviation psychology" is being established at the University of Tennessee through the cooperation of both state and national organizations. The Civil Aeronautics Administration and the Tennessee State Bureau of Aeronautics are providing funds for the institute. A committee of the National Research Council in cooperation with the special project committee of the University of Tennessee will direct research. Colonel Herbert Fox, of the Tennessee Bureau of Aeronautics, has been active in establishing the institute.

Special attention will be given to problems of training and to developing methods of instruction and training aids which can help to reduce failures among student pilots and to decrease the incidence of accidents following the completion of training. Research work has already been carried out by the Government

at various universities, with funds made available by the Civil Aeronautics Administration, under the general supervision of an executive subcommittee of the National Research Council Committee on Selection and Training of Aircraft Pilots consisting of Dr. Charles W. Bray, Dr. Dean R. Brimhall, Commander Daniel J. Brimm, Dr. Leonard A. Carmichael, Lieutenant Commander Jack W. Dunlap, Lieutenant Colonel John C. Flanagan, Professor Harry M. Johnson, Dr. Walter R. Miles, Dr. G. R. Wendt and Professor Morris S. Viteles, *chairman.*

Research projects, in consultation with the Division of Research of the Civil Aeronautics Administration, will be planned jointly by Dr. Robert Y. Walker, formerly of the Ohio State University, director of the institute; the project committee of the University of Tennessee, including Professors E. S. Fabian, K. L. Hertel, P. B. Stockdale and Dr. E. A. Waters, and the executive subcommittee of the Committee on Selection and Training of Aircraft Pilots. The staff of the institute will include Dr. R. E. Dunford and S. E. Torsten Lund, of the University of Tennessee, as well as others drawn from current projects of the Committee on Selection and Training of Aircraft Pilots. It is anticipated, however, that work will continue on a number of projects centered at other universities.

Headquarters will be at the university, but special facilities for research will be provided at the University Airport, formerly known as "Island Airport" in Knoxville.

Establishment of the institute represents the fulfilment of plans formulated by Dr. Dean R. Brimhall, director of research of the Civil Aeronautics Administration, in consultation with the committee of the National Research Council. The committee believes that "the establishment of an institute of aviation psychology at a state university, supported by state as well as by federal funds, represents a method of assuring the continuation of such research in the postwar era with a renewed emphasis upon the problems of civilian flying. Through such an institute and others like it at other universities, steps can be taken to avoid the unfortunate cessation of basic and practical research which occurred at the close of the last war."

THE LECTURESHIP ON METALLURGY AT THE UNIVERSITY OF SAO PAULO

Dr. Robert F. Mehl, professor and head of the department of metallurgical engineering and director of the Metals Research Laboratory of the Carnegie Institute of Technology, Pittsburgh, left on February 13 for Brazil to deliver the second of a series of lectures on metallurgy established last summer at the Escola Politecnica of the University of São Paulo. The project is jointly financed through the office of Nelson A. Rockefeller, coordinator of Inter-American Affairs, and the university and is administered by the Stevens Institute of Technology.

Professor Mehl is the second of four United States authorities in the field of metallurgy to deliver lectures on this subject over a period of a year, each spending three months in São Paulo. The first lecturer was Dr. A. Allan Bates, manager of the metallurgical department of the Research Laboratories of the Westinghouse Electric and Manufacturing Company, East Pittsburgh. The third lecturer in the series will be Professor Arthur Phillips, of the Hammond Metallurgical Laboratory at Yale University, and the fourth Professor Gregory Jamieson Comstock, director of the Powder Metallurgy Laboratory at Stevens Institute.

Professor Bates's lectures covered industrial research and development in metallurgy. Dr. Mehl will lecture, beginning on March 1, on the physical metallurgy of iron and steel. Laboratory facilities for metallurgical work are available in São Paulo at the Instituto de Pesquisas Tecnologicas, which is connected with the Escola Politecnica. Modern research and production equipment is provided.

In addition to the formal lectures, which are given in English, oral conferences, attended by representatives from industry, have been arranged. These are conducted by means of questions and answers, with interpreters in attendance. Manufacturing practices employed in the United States and specific details from the viewpoint of Brazilian practices are the subjects of discussion.

CONFERENCE OF THE INSTITUTE OF FOOD TECHNOLOGISTS

The fifth annual meeting of the Institute of Food Technologists will be held in Chicago at the Edgewater Beach Hotel on May 29, 30 and 31. The program will include addresses and the presentation of technical papers by authoritative speakers. An attendance is expected of more than seven hundred chemists, physicists, biologists, engineers and production executives engaged in food manufacturing and processing.

The presentation of the Nicholas Appert Medal Award for 1944 of the Chicago Section will be made on May 30 to Dr. Charles Albert Browne, of the U. S. Department of Agriculture, in recognition of "outstanding contributions to food technology." The ceremony will be preceded by a banquet at the hotel.

The medal was presented for the first time in 1942 when the award went to Dr. W. V. Cruess, professor of fruit products at the University of California.

Dr. S. C. Prescott, dean emeritus of science of the Massachusetts Institute of Technology at Cambridge and first president of the institute, was the recipient of the second award last year.

Announcement of the selection of Dr. Browne to receive the 1944 medal was made on February 15. The medalist is elected by a jury of nine distinguished technologists representing various divisions of the food processing industry and from as many different geographical areas. Eligibility for the award is based on preeminence in the field of food technology and on contributions to the progressive development of food manufacture and processing.

Dr. Browne's contributions to food technology began in his undergraduate years at Williams College when he began the study of carbohydrates. He received his doctorate at the University of Göttingen. Later he was successively chief of the Sugar Laboratory of the U. S. Bureau of Chemistry, chief chemist of the New York Sugar Trade Laboratory, chief of the Bureau of Chemistry and chief of chemical and technological research of the Bureau of Chemistry and Soils. The citation reads in part: "He has been an unfettered investigator who struggled to remain free of administrative burdens, finally culminating in his appointment as supervisor of chemical research. He is justly deserving of the honor of the Nicholas Appert Medal if only for his researches and contributions to sugar technology, constituting as they do to-day an imposing and vital section of the literature and technology of carbohydrates." Presentation of the award will be made to Dr. Browne by Dr. M. L. Laing, chairman of the Chicago Section.

A feature of the meeting again this year will be an industrial exhibit in the hotel. Space will be assigned for thirty exhibits, which will be free to the public.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

At the meeting of the Executive Committee of the American Association for the Advancement of Science on February 6, the following actions were taken:

Section committeemen for a four-year term ending December 31, 1947:

Mathematics, T. R. Hollcroft, Wells College.

Physics, Joseph C. Boyce, Massachusetts Institute of Technology, Cambridge, Mass.

Astronomy, Bart Jan Bok, 32 Scott Road, Belmont, Mass.

Geology and Geography, Carey Croneis, University of Chicago.

Zoological Sciences, Charles W. Metz, University of Pennsylvania.

Botanical Sciences, J. W. Shive, New Jersey Agricultural Experiment Station.

Anthropology, Ralph Beals, University of California at Los Angeles.

Psychology, Willard L. Valentine, 620 University Place, Evanston, Ill.

Social and Economic Sciences, Frederick C. Mills, Columbia University.

Historical and Philological Sciences, Arno B. Luckhardt, University of Chicago.

Medical Sciences, N. C. Foot, 340 East 72nd Street, New York, N. Y.

Agriculture, C. E. Kellogg, U. S. Agricultural Research Administration.

Education, S. R. Powers, Teachers College, Columbia University.

It was voted to hold the annual meeting of the association for 1944 in Cleveland, Ohio, during the week of September 11–16.

It was voted to bring to the attention of the association and of all the affiliated societies that in all programs of the September meeting emphasis be placed on the indispensability of science for the future of civilization, both in war and in peace.

Publication of the conference on hormones, presented at the Gibson Island Research Conferences in Chemistry in 1943, was authorized.

The Population Association of America and the Electron Microscope Society were accepted as associated societies of the association.

The election of Dr. Burton E. Livingston as chairman and of Dr. Roger Adams as a member of the committee and the election of vice-presidents of the sections were reported last week (SCIENCE, February 11, pp. 120–121).

SCIENTIFIC NOTES AND NEWS

DR. IRVING LANGMUIR, associate director of the General Electric Research Laboratory, has been awarded the Faraday Medal of the Institution of Electrical Engineers, London. The medal was established in 1922 and is given for world-wide services to electric science and engineering. Among those who have received the award are Oliver Heaviside, Sir J. J. Thomson, Lord Rutherford and Sir Oliver Lodge. Dr. Langmuir is the fourth American to receive this medal. In 1927 it was given to Professor Elihu Thomson, one of the founders of the General Electric Company; in 1935 to Dr. Frank B. Jewett, president of the Bell Telephone Laboratories, and in 1939 to Dr. William D. Coolidge, vice-president in charge of research of the General Electric Company.

THE Medal of Honor of the American Institute of Radio Engineers was presented at the annual dinner on January 28 to Haraden Pratt, chief engineer of the Mackay Radio and Telegraph Company, "in recog-

nition of engineering contributions to the development of radio." The Morris Liebmann Memorial Prize for 1943 was presented to W. L. Barrow, professor of electrical engineering at the Massachusetts Institute of Technology, "for theoretical and experimental work done in ultra-high frequency propagation." Speakers at the dinner included Dr. Lynde P. Wheeler, the retiring president of the institute, and Professor H. M. Turner, of Yale University, the newly elected president.

THE Faculty of Medicine of the University of Toronto has awarded the Charles Mickle Fellowship for 1943 to Dr. Evarts A. Graham, Bixby professor of surgery at the School of Medicine of Washington University, St. Louis, surgeon-in-chief of the Barnes Hospital, in recognition of "his discovery of a method of testing gallbladder functions by the use of certain organic compounds and the diagnosis and treatment of carcinoma of the lung."

THE William Herbert Medal, awarded annually by the American Amaryllis Society for outstanding achievement in the field of the Amaryllidaceae, has been presented to Dr. Henry A. Jones, principal olericulturist at the station at Beltsville, Md., of the U. S. Bureau of Plant Industry, in recognition of his "important contributions to the cytology, genetics, breeding and culture of the onion, *Allium Cepa*."

A PORTRAIT of Dr. Frederic A. Woll, chairman of the department of hygiene at the College of the City of New York, presented to the college by the department, was unveiled on January 29.

DR. HELEN M. WALKER, professor of education at Teachers College, Columbia University, has been elected president for 1944 of the American Statistical Association. She succeeds E. A. Goldenweiser, director of the Federal Reserve Bank, Washington, the retiring president.

IT is reported in *The British Medical Journal* that the Medical Research Council of Ireland has awarded full-time fellowships to Dr. V. C. Barry, for investigations on the chemotherapy of tuberculosis; to Dr. Michael Flynn, on the typhoid-carrier condition; to Dr. P. A. McNally, on the chemotherapy of tuberculosis, and to Dr. Dermot Murphy, on the production of penicillin.

DR. JOHN M. FOGG, JR., associate professor of botany and dean of the College of Arts and Sciences, has been elected vice-provost of the University of Pennsylvania.

AT the University of Florida, Dean H. Harold Hume has been appointed provost for agriculture and dean of the College of Agriculture to succeed the late Dr. Wilmon Newell; Harold Mowry, associate director, has been promoted to be director of the Agricultural Experiment Station, and A. P. Spencer to be director of the Agricultural Extension Service.

DR. ARILD E. HANSEN, professor of pediatrics at the Medical School of the University of Minnesota, has become professor of pediatrics and chairman of the department of pediatrics in the School of Medicine at Galveston of the University of Texas and director of the Child Health Program at the university of the William Buchanan Foundation of Texarkana. The Child Health Program plans the further development and expansion of the department of pediatrics, to include research and to create opportunities for practicing physicians to participate more effectively in promoting child health.

DR. C. V. NEWSON, of the University of New Mexico, has been appointed professor of mathematics and head of the department of Oberlin College. He will take up his new work on July 1.

DR. W. W. WORZELLA, associate in agronomy at Purdue University, has been made head of the department of agronomy of South Dakota State College.

DR. ELIZABETH KRAUSKOPF BUSHNELL, adjunct professor of bacteriology at the University of South Carolina, has been appointed, effective on February 1, assistant professor of bacteriology at the University of Hawaii.

DR. GEORGE B. DARLING has resigned as president and comptroller of the W. K. Kellogg Foundation in Battle Creek to accept appointment as executive secretary of the Committees on Military Medicine of the Division of Medical Sciences of the National Research Council, Washington, D. C.

MAURICE HOLLAND, for twenty years director of the engineering and industrial research division of the National Research Council, has been appointed industrial research adviser to the Armour Research Foundation of Chicago.

DEAN SAMUEL T. DANA, of the School of Forestry and Conservation of the University of Michigan, editor of the *Journal of Forestry*, has become a member of a subcommittee of the Michigan State Planning Commission, formed to recommend the development of industrial and natural resources in the Upper Peninsula; he has also been made a member of the advisory council to aid in a survey of the effects of the war on the forest resources of the United States.

CHARLES H. BRIGGS has joined the staff of the Truesdail Laboratories of Los Angeles. For forty-two years he has been manager of the Howard Wheat and Flour Testing Laboratory of Minneapolis, where he took part in introducing and perfecting some of

the chemical and physical tests applied to cereals and their products, including the protein test of wheats.

DR. LOWELL T. COGGESHALL, professor of epidemiology at the School of Public Health of the University of Michigan, has leave of absence to enable him to become medical director for the Marine Rehabilitation Program on the west coast.

DR. ROGER C. SMITH, head of the department of entomology of the Kansas State College, has been granted leave of absence to become professional allocations specialist of the War Manpower Commission for the Agricultural and Biological Sciences. He took up this work in Washington, D. C., on February 1.

DR. KIRTLEY F. MATHER, professor of geology at Harvard University, editor of the Scientific Book Club, lectured on February 17 before the Lancaster Branch of the American Association for the Advancement of Science. He spoke on "Natural Resources and World Organization."

THE address of Dr. Leland W. Parr, of the School of Medicine of the George Washington University, delivered on February 17 as retiring president of the Washington Academy of Sciences, was entitled "Aspects of the Epidemiology of Tuberculosis."

AT the meeting on January 21 of the Johns Hopkins Medical History Club, Dr. G. L. Streeter spoke on "The Origin of the Three Germ-Layer Theory and Its Present Significance," and Dr. Erwin H. Ackerknecht spoke on "White Indians."

DR. B. H. WILLIER, professor of biology at the Johns Hopkins University, addressed the Alpha Mu Chapter of Beta Beta Beta at Western Maryland College on January 31. His address was entitled "The Development of Color Patterns in the Feathers of Chickens."

DAVID DIETZ, science editor of the Scripps-Howard Newspapers, addressed the scientific staff of the Goodyear Research Laboratory in Akron, Ohio, on January 31. He spoke on "Science and the Future."

DR. K. C. D. HICKMAN, vice-president and director of research of the Distillation Products, Inc., Rochester, N. Y., will deliver Sigma Xi lectures on the general subject of vitamins during February and March at Swarthmore College, the University of Virginia, the Virginia Polytechnic Institute, the University of North Carolina, the University of Florida, Emory University, the Louisiana State University, the University of Illinois, Indiana University, Michigan State College, Western Reserve University and the University of Missouri.

THE Council of the American Association of Pathologists and Bacteriologists has voted that a scientific meeting of the association will not be held in the year 1944.

THE thirty-fifth annual meeting of the American Oil Chemists Society will be held in New Orleans, on May 10, 11 and 12. The Roosevelt Hotel has again been selected as headquarters for the convention and all technical sessions, committee meetings and the annual dinner will be held there. The local committee, of which Dr. George W. Irving, Jr., of the Southern Regional Research Laboratory at New Orleans, is chairman, is arranging a program of papers which will include the chemical, analytical, technological, industrial and economic phases of fats and oils. Interested guests may register. Hotel reservations should be made as soon as possible through Roy R. Bartlett, convention manager of the hotel.

THE dedication of the M. D. Anderson Hospital for Cancer Research at Houston, Texas, under the auspices of the M. D. Anderson Foundation of the University of Texas, of which Dr. E. W. Bertner is acting director, took place on February 17. The guest speakers included The Honorable Coke Stevenson, Governor of Texas; Dr. Homer P. Rainey, president of the University of Texas; Dr. Charles S. Venable, president of the State Medical Association; Dr. Bowman C. Crowell, associate director of the American College of Surgeons; Dr. Frank E. Adair, chief surgeon of the Memorial Hospital, New York, and Dr. Clarence C. Little, managing director of the American Society for the Control of Cancer. The address of welcome was made by the Honorable Otis Massey, mayor of the City of Houston.

THE fortieth anniversary of the first flight of the Wright brothers and the thirty-fifth anniversary of Russian aviation were recently celebrated by a meeting of the Scientific Council of the Ordzhonikidze Aviation Institute in Moscow.

THE British Minister, John Balfour, on January 6 presented to the Soviet Academy of Science a first edition of Isaac Newton's "Principia," a gift from the Royal Society. This book contains the original of a letter writter by Newton to Alexander Menshikoff.

THE *Journal* of the American Medical Association reports that funds estimated at more than eight million dollars have been left in trust by the late Mrs. Elizabeth Severance Prentiss for the advancement of medicine, health, art, music, education and religion. Thirty-seven per cent. of the assets are set aside to support the Elizabeth Severance Prentiss Foundation. The institutions that will receive trust assets reserved for the public welfare include Western Reserve University, seven per cent., Cleveland Museum of Health and Hygiene and Oberlin College, each five per cent., the Allen Memorial Medical Library, three per cent.,

and Berea College, Berea, Ky., one per cent. A separate fund will be in trust for each of these institutions. It is provided that sixty per cent. at least of all disbursements be made in the State of Ohio.

It is reported in *The Times,* London, that a new organization, the Council for the Promotion of Field Studies, was formed at a recent meeting, held at the British Museum (Natural History) South Kensington, attended by representatives of universities, scientific societies and other bodies in many parts of the country. Professor F. E. Fritsch presided, and the proposal for the establishment of the council was put forward by F. H. C. Butler, who explained that support for the scheme had been promised by the Board of Education and the Scottish Education Department as well as by a number of learned societies. He suggested that the existing facilities for the study of natural history at first hand needed to be much improved, and that the best method of doing this would be to create a certain number of hostels for field studies in appropriate localities, each under a trained warden.

According to *Nature* at the sixth meeting of the Conference of Ministers of Education of the Allied Governments held at the offices of the Board of Education last October, it was agreed to establish an Inter-Allied Bureau to carry out the practical steps needed to restore educational services in the countries concerned. This bureau will be the executive body of the conference. The work to be undertaken by the bureau includes the purchase and distribution of books and periodicals, the preparation of films and other visual aids and the supply of scientific equipment. These matters are at present being considered by commissions of the conference. The bureau was also asked to consider financial needs and methods of contribution by governments and the establishment of an inter-allied secretariat.

The Times, London, under date of December 16, writes: "Mr. Attlee, who was accompanied by the Chancellor of the Exchequer, Sir William Jowitt, and Lord Cherwell, received an influential deputation from the Parliamentary and Scientific Committee. The purpose of this deputation, which was led by Lord Samuel, was to urge the government to give more direct encouragement to scientific and technical training and research as an essential part of the plans for promoting industrial reconstruction after the war. E. W. Salt, chairman of the committee, specifically asked that the universities should be given an additional grant of £1,000,000 for the extension of research and training facilities; and that the Government should allot a day for a House of Commons debate on science and the future of industry." Mr. Attlee, replying, said that, although he could not anticipate the budget, he believed the Treasury was "sympathetically inclined," and that plans for science, both fundamental and applied, held a high place in the minds of all members of the Government.

DISCUSSION

THE DIRECTION OF ROTATION IN SPIRAL NEBULAE

In Science for May 9, 1941, appeared a noteworthy abstract of a paper given before the National Academy of Sciences, under the above title, by the joint authors, Drs. Hubble and Mayall. Because of my early work on the radial velocity and the rotation of spiral nebulae I quite naturally have since been keenly interested in later observations in this field.

Their paper itself seems not to have been published and this abstract unfortunately lets the work appear something of a tour de force in science and could give the reader the impression that in astronomy we are drawing broad conclusions from narrow premises. In particular, the authors' statements that this is "... the first unambiguous determination of the direction of rotation of a spiral nebula" and that "... of the 1,000 brightest nebulae . . . only one system, NGC 3190," was found suitable to decide the direction of rotation, are too enthusiastic and too sweeping in their implications.

This "first unambiguous determination" is not the first, for it only confirms the winding-spring-like rotation of spirals that was well established twenty-six years ago, at Lowell Observatory, with a more powerful spectrograph;[1] a determination based upon the observation not of one but of several selected nebulae, some of which are among the best known and most suitable in the sky; and included a particularly searching study of the great Andromeda nebula because of its supreme fitness for affording decisive evidence on the direction of spiral rotation. Moreover, this early study of rotation of spiral nebulae followed a decade of similar work of mine on the rotations of the planets which had developed effective means and methods—not yet superseded—that have been advantageous in the study of rotation in the spirals.

In his more recent extended paper in the *Astrophysical Journal* for March, 1943, Hubble includes four of my early nebulae among the first eight of his list of "Well-observed Nebulae," and confirms and ac-

[1] *Proc. Am. Phil. Soc.,* 56: 403, 1917; and *Lowell Obs. Bull.* No. 80, 1917, etc.

cepts the judgment made by me in 1917, namely, that the spiral nebulae rotate in the direction of the arbor of a spiral spring that is being wound up; in his new words "they trail their arms."

V. M. SLIPHER

LOWELL OBSERVATORY,
FLAGSTAFF, ARIZ.

THE PERFUSION OF RAT LIVERS

J. SCHILLER and G. Pincus report in the November 5 issue of SCIENCE on the "perfusion of rat livers with estrogen in vitro."

In Table 1, page 412, they present data which they interpret as controverting the findings of Heller and Zondek. Upon analyzing their data, however, we find them to be entirely in accord with our concepts of estrogen inactivation as set forth in *Endocrinology*, 32: 64, 1943, and *Endocrinology*, 26: 619, 1940.

(1) Their failure to find hepatic conjugation of estrogens is wholly in agreement with our findings that this mechanism for metabolizing estrogens plays an insignificant role in estrogenic inactivation.

(2) They find that amounts of α-estradiol as large as 208 r. u. are completely inactivated by perfusion through the liver in a period of 3 hours. Only a small percentage was recovered when as much as 300 r. u. was perfused through the liver, whereas 90 per cent. was recovered when 300 r. u. was perfused through the heart for a similar period of time. If the 208 r. u. of α-estradiol had been converted to estrone or estriol by the liver, as postulated by these authors, measurable activity should have been obtained from the perfusate. The fact that they found none beyond the amount found in control perfusate experiments to which no estrogen had been added is in keeping with our data that α-estradiol is destroyed by the liver when present in small or physiological quantities. Our own experiments indicate that the destruction is accomplished with the aid of an oxidative enzyme system.

(3) When they used very large amounts (3200 r. u. in the perfusate) one third of the activity was recovered. Their data obtained through fractionation experiments are unclear, since calculation of the estrogen fractions in terms of weight shows a recovery of 650 γ (50 γ as estradiol, 400 γ as estrone and 200 γ as estriol) when only 400 γ of α-estradiol had been added to the perfusate originally. However, their biological data, showing recovery of one third of a massive dose of 3200 r. u., fit in with our concept that "the liver and kidneys have a definite threshold capacity for oxidizing α-estradiol. Any amount above the threshold will escape oxidation. . . . At least two mechanisms for dealing with estrogen occur in the body, (*a*) an oxidative mechanism which inactivates the greater part of *physiologically* circulating estrogens, and (*b*) an overflow mechanism which operates mainly after liver oxidative capacity is reached. . . ." We also conceded that this overflow mechanism involved conjugation of free estrogens or transformation of one estrogen into another.

The data these authors present thus confirm the results of our experiments, although the conclusions they reach from their own data "controvert" our findings.

CARL G. HELLER

WAYNE UNIVERSITY

ANTHRACITE COAL ASHES FOR ROOTING CUTTINGS

A NOTE in SCIENCE,[1] of a few months ago, suggested to victory gardeners the use of sifted anthracite coal ashes to improve the texture of heavy clay soils. May I suggest another use for this material?

My father, who operated a successful wholesale cut flower business for many years in New York City, found during his later years that sifted hard coal ashes from the furnaces used to heat his greenhouse were excellent for the propagation of cuttings of chrysanthemums, roses, bouvardia, etc. Damping off was unknown in his cutting beds and mortality from other causes was very low. In addition, cuttings developed a fine ball of roots, and showed an exceptional vigor which the plants retained to maturity. No soil treatment was ever found necessary, water retention was adequate and aeration was excellent.

MILDRED P. MAULDIN

SOIL CONSERVATION SERVICE SEED
TESTING LABORATORY,
SAN ANTONIO, TEXAS

[1] SCIENCE, January 8, 1943.

JOULE AGAIN

LETTERS covering three fourths of p. 602 in the November 20, 1943, issue of *Nature* make desirable a restatement of what was said in SCIENCE in the issue of January 20, 1933: In the summer of 1897, while being conducted through the Physics Laboratory of the University of Edinburgh by Professor P. G. Tait, I chanced to ask him how we should pronounce the name of the physicist Joule. He smiled and said, "Well, I used to work with him and I can only say that he always called himself Joule," sounding the *ou* as in *you*.

Soon after the publication of this communication of mine in SCIENCE, Sir D'Arcy W. Thompson, of the University of Aberdeen, wrote me a letter from which I take the liberty of quoting: "You are perfectly right. The matter is not in doubt. *Joule* (*ou* as in *you*) is the great man's name, and every English physicist from Kelvin and Tait downwards—or onwards—has always called him so."

Yet the latest edition of Webster's Dictionary persists in making Joule rhyme with jowl, and the Standard Dictionary gives the preference to this pronunciation.

In time, I presume, the editors of those two dictionaries will concede that Joule knew how to pronounce his own name.

JOSEPH O. THOMPSON

AMHERST COLLEGE

SCIENTIFIC BOOKS

BIOPHYSICS

An Introduction to Biophysics. By OTTO STUHLMAN, JR. 375 pp. 155 figures. New York: John Wiley and Sons, Inc. $4.00.

THIS book on biophysics was written to serve the needs of students in biology who have had one year of college mathematics and one year of college physics. The treatment of the subjects is sufficiently clear and restricted so that a student with the above preparation should have little difficulty in reading the book. The author has exercised admirable restraint in terminating his treatment of a subject before reaching the more complex aspects and has avoided the excessively descriptive treatment characteristic of biological subjects. The treatment of subjects ranges from mere descriptions of applications of physical instruments to attempted interpretations of biological processes in terms of the principles of molecular physics.

One objective in writing such a book should be to reveal the scope of biophysical investigation. This the book does well, since the chapters include discussions of cell membranes and surfaces, of properties of nerves and the special sense organs, of the action and use of various radiations and radioactive materials, and, finally, a description of the principles and uses of the compound microscope and the electron microscope. This array of subjects, though not exhaustive, serves well to illustrate the application of physical principles, methods and instruments in the solution of biological problems.

A second objective, of great importance in a first course in any science, should be to reveal or formulate a logical structure of the subject-matter. In a textbook this can be achieved not only by choice of material but by the order of presentation of this material. From this viewpoint the book is deficient because the arrangement of chapters is dictated largely by the divisions of classical physics rather than by the systematic development of a science of biophysics. Thus the first four chapters deal with some aspect of radiation in relation to organisms. Chapter one is about x-rays, chapter two deals with radioactivity, chapter three with the properties of the eye, and chapter four discusses the emission and absorption of light by biological materials. The field of chemical or molecular physics is represented to some extent by chapter five on the properties of surfaces and membranes. Chapter six is primarily about the electrical properties of nerve; sound and auditory mechanisms are taken up in chapter seven. The last chapter is a discussion of the properties and use of the compound microscope and the electron microscope. Thus are represented most of the usual divisions of physics: radiation, molecular physics, electricity and sound.

This text structure is an unfortunate one, since it has no logical order which defines the field of biophysics as a unique scientific approach to the interpretation of living processes.

However, the order of presentation of material can be rearranged, since understanding of the content of any one chapter of the book does not depend in any important way upon that of other chapters. Therefore, this book could be used to advantage even in a course organized for the purpose of giving the student an impression of a logical science based on the principles of biology and physics. In such a course the chapters dealing primarily with physical instruments and methods could be brought in as a group representing the methodology of biophysics. The limited material directly relating to cells and organisms in chapters one, two and four could be discussed in relation to cellular mechanisms rather than physical methodology. The latter is extremely important to the subject and should never be omitted. It should not, however, define the organization of material contained in a course in biophysics.

Although it may be questioned whether this book adequately represents the scope of biophysics as a distinct science, it will be a very useful adjunct to a course in physics designed for students in pre-medical and biological fields.

FRANK BRINK

POTASH

Potash in North America. By J. W. TURRENTINE. 6 × 9 in. 186 pp. Illustrated. New York: Reinhold Publishing Corporation. 1943. $3.50.

ABOUT sixty years have passed since potash fertilizers in this country were first prepared from inorganic sources. During the first half of this period the entire supply was imported from Germany. The disadvantages of dependence on a foreign source for such an essential commodity was repeatedly stressed, and the demand for a domestic source of supply increased with increase in consumption of potash in fertilizers. With a view to meeting this demand, Con-

gress in 1911 made a specific appropriation for the Bureau of Soils, U. S. Department of Agriculture, for "exploration and investigation within the United States to determine a possible source of supply of potash, nitrates and other natural fertilizers." At the same session in 1911, the Geological Survey was authorized to make exploratory borings to determine the possible existence of potash deposits within the United States. In 1916 another item was added in the appropriation act for the "investigation and demonstration within the United States to determine the best method of obtaining potash on a commercial scale."

The book under review is the second of a series of two books by the same author describing the research, exploration and development work on potash that followed the enactment of these appropriation acts. The first of these two books entitled "Potash: A Review, Estimate and Forecast," covers the period 1911 to 1926. The second of the series begins where the first left off and covers the fifteen-year period following 1926. The first chapter reviews the progress that has been made in the production of potash during this period in various countries of the world as well as in the United States. It reviews also the purposes and activities of the American Potash Institute, which was organized in 1935. The second chapter outlines the uses of potash in agriculture and in the chemical industries and gives statistical data on American and World Trade in potash salts between 1926 and 1941. In the third chapter detailed information is given on the technology of potash production at Searles Lake and in the New Mexico field.

This book is one of the American Chemical Society Series of Scientific and Technologic Monographs and it is in keeping in every respect with the high standards set by the society for this series of publications. The author is recognized as having taken a leading part in all research and development work on potash since this was first undertaken in 1911. The present book, as with the first of the series, can, therefore, be recommended without reservation to those who are interested in securing the most authoritative information available on the history and development of the American potash industry.

William H. Ross
Division of Soil and Fertilizer Investigations,
U. S. Department of Agriculture,
Beltsville, Md.

SPECIAL ARTICLES

THE DISINTEGRATION OF MACROMOLECULAR TISSUE LIPOPROTEINS[1]

The thromboplastic protein (inducing the formation of thrombin) isolated by the ultracentrifugal fractionation,[2] or, in considerably less pure form, by the fractional salt precipitation[3] of beef lung extracts is a macromolecular lipoprotein. As has been described previously,[2] preparations may be obtained under proper conditions that exhibit homogeneity of sedimentation and electrophoretic mobility, have the extremely high particle weight of 170 million (from rate of sedimentation), and appear in electron micrographs as spheres with a diameter of 80 to 120 mμ. Apart from their extremely high thromboplastic potency (as little as 0.008γ being demonstrable by clotting tests), these preparations were distinguished by a marked phosphatase activity.

The thromboplastic protein of beef lungs resembles in certain outward respects, *e.g.*, its analytical composition and content of acetal phosphatides, the submicroscopic particles isolated from a number of tissues.[4] As is true of most natural lipoproteins,[5] the lipids forming part of the thromboplastic protein[3, 6] are held vigorously and can be removed only by exhaustive extraction with alcohol-ether which renders the protein moiety insoluble and inactive.

It was recently shown by McFarlane[7] that a large proportion of the serum lipids, ordinarily not extractable with ether, may be transferred into the ether phase, when ether-containing serum is frozen below −25° and allowed to thaw. The application of a similar technique to the thromboplastic protein and other lipoproteins gave interesting results.

In a typical experiment, summarized in Table 1, a solution of 330 mg of the thromboplastic protein in 15 cc of borate buffer of pH 8.5 was mixed with 10 cc of ether (free of peroxides and alcohol), kept for 4 minutes at −30°, and permitted to thaw. This operation was, after replacement of the ether layer by fresh solvent, repeated six times. From the aqueous phase, freed of the remaining ether by careful evacuation, a large proportion of the protein could be isolated by centrifugation at a low speed as Fraction A which exhibited somewhat higher thromboplastic and phosphatase activities than the original material. A small amount of practically unaltered thromboplastic

[1] This work has been supported by a grant from the John and Mary R. Markle Foundation.

[2] E. Chargaff, D. H. Moore and A. Bendich, *Jour. Biol. Chem.*, 145: 593, 1942.

[3] S. S. Cohen and E. Chargaff, *Jour. Biol. Chem.*, 136: 243, 1940.

[4] A. Claude, Science, 97: 451, 1943.

[5] E. Chargaff, "Advances in Protein Chemistry," vol. 1, 1944 (in press).

[6] S. S. Cohen and E. Chargaff, *Jour. Biol. Chem.*, 139: 741, 1941.

[7] A. S. McFarlane, *Nature*, 149: 439, 1942.

TABLE 1

DISINTEGRATION OF THROMBOPLASTIC PROTEIN BY FREEZING IN PRESENCE OF ETHER

Fraction	Centrifugal characteristics			Electrophoretic characteristics*		Proportion of starting material	N	P	Thromboplastic activity†	Phosphatase activity‡	
	Duration of centrifugation	Centrifugal force	Sedimentation	Mobility	Area					Phosphatase units per mg	Initial activity per mg
	min	*g*		*(u × 10⁵)*		*per cent.*	*per cent.*	*per cent.*	γ		*A100*
Thromboplastic protein	30 90	5,000 31,000	No Complete	7.59	100		7.6	1.6	0.008	1.56	4.49
A	30	1,900	Almost complete			50.4	8.3	1.4	0.003	2.73	5.58
B	30 90	1,900 31,000	No Complete			7.5	8.1	1.5	0 008	2.01	4.36
C	90	31,000	No	3.34 6 55 8.07	25 46 29	15.8	12.1	0 70	Inactive up to 6γ	2 02	4.52
D } Control experiment	30 90	1,900 31,000	No Almost complete			98.1	7.2	1.6	0 003	0.9	1.83
E } Control experiment	90	31,000	No			1.7			0.03	0 7	1.20

* The experiments were carried out in borate buffer of pH 8.5. The computation of mobilities and relative areas is based on the descending boundaries.

† Expressed as smallest amount clotting 0.1 cc of rooster plasma within 30 minutes. The experiments were carried out at 30 6° by mixing 0 1 cc of fresh rooster plasma (normal clotting time above 80 minutes) with 0.03 cc of the solution of the protein in borate buffer, pH 8.5.

‡ The determinations were carried out in the presence of Mg ions. For the experimental arrangement and the definition of the units, compare.[2]

protein could be separated by high-speed centrifugation (Fraction B). The supernatant then was found to contain a considerable proportion of a mixture of non-sedimentable proteins (Fraction C) which, while quite active as phosphatase, was devoid of thromboplastic activity. A lipid fraction (rich in acetal phosphatides) amounting to 18 per cent. of the starting material, *i.e.,* roughly one third of the total lipids of the thromboplastic protein, was recovered from the combined ether extracts. A control experiment carried out simultaneously with the omission of ether failed to reveal an appreciable aggregation or disruption of the protein or other gross changes due to the freezing: the sedimentation of the protein (Fraction D), almost negligible at 1900 g, became practically complete at 31,000 g. The supernatant contained only traces of protein (Fraction E). Fraction D showed a higher thromboplastic and a lower phosphatase activity than the untreated protein; but this effect of freezing on the phosphatase potency was not observed to that extent with other preparations.

The view of the structure of lipoprotein complexes, based on x-ray evidence, as thin protein layers inserted between bimolecular lipid leaflets,[3] appears to permit the assumption that these units could arrange in a regular manner to form large complexes whose size would perhaps be limited by the intracellular spaces in which their formation takes place. The importance of the lipids in maintaining uniformity of particle size and electrophoretic mobility could thus be understood. The isolation of a fraction (consisting of three electrophoretically distinct components) having marked phosphatase, but no thromboplastic activity (Fraction C) is indicative of the far-reaching changes produced by even the partial removal of the lipids from the ostensibly homogeneous complex, once the protective water barrier is frozen away. It should be of interest to apply this technique to some of the animal viruses which, as isolated from infected tissues, are reported to occur in form of, or attached to, lipoproteins of very high particle weight.

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[3] K. J. Palmer, F. O. Schmitt and E. Chargaff, *Jour. Cell. and Comp. Physiol.,* 18: 43, 1941.

THE OPTICAL ROTATION OF CELLULOSE AND GLUCOSIDES IN CUPRAMMONIUM HYDROXIDE SOLUTION

THE high (levo) optical rotation of cellulose in cuprammonium hydroxide solution is believed to be a property of a complex formed by a copper-containing radical and free hydroxyl groups of cellulose. Neither the composition of the copper radical nor the points of its engagement with cellulose have been known with certainty. The following experiments (Table 1) show that complexes of similar high rotation are formed when appropriately substituted simple glucosides are dissolved in cuprammonium hydroxide solution. The levo-rotatory complex appears to be a cyclic structure involving hydroxyl groups on glucose carbon atoms

2 and 3. This conclusion is in agreement with the speculations of others regarding the structure of the copper-cellulose complex.[1] The formation of a highly levo-rotatory complex does not require that the glucosidic units be linked together in a polysaccharide.

β-Methyl glucoside dissolved in cuprammonium hydroxide solution does not show a levo rotation. However, β-methyl-4-methyl glucoside, which possesses the same free and substituted positions as cellulose, shows optical activity remarkably like that of cellulose. Similar behavior is exhibited by α- and β-methyl glucosides substituted in positions 4 and 6. In these cases only hydroxyl groups on positions 2 and 3 are available for engagement with the copper radical.

TABLE 1

The Optical Rotation (Hg Blue Line) in Water and Cuprammonium Hydroxide Solution of Cellulose and Some Methylglucosides*

Substance	Solvent†	$[\alpha]^{25}_{436}$		$[M]^{25}_{436}$
Cellulose (Purified cotton fiber)‡	Cupra	− 1200°		− 194,400°
	Water-Triton B(1:1)	− 46°		− 7,500°
			Dif.	− 186,900°
β-Methyl-4-methyl glucoside	Cupra	− 1008°		− 209,700°
	Water	− 36°		− 7,500°
			Dif.	− 202,200°
β-Methyl-4,6-ethylidene glucoside	Cupra	− 1058°		− 234,800°
	Water	− 163°		− 36,200°
			Dif.	− 198,600°
α-Methyl-4,6-benzylidene glucoside	Cupra	− 608°		− 171,500°
	Water	+ 159°		+ 44,800°
			Dif.	− 216,300°
β-Methylglucoside	Cupra	+ 67°		+ 13,000°
	Water	− 62°		− 12,000°
			Dif.	+ 25,000°
α-Methylglucoside	Cupra	+ 432°		+ 83,800°
	Water	+ 306°		+ 59,400°
			Dif	+ 24,400°
α-Methyl-2,4-dimethyl glucoside	Cupra	+ 275°		+ 61,000°
	Water	+ 308°		+ 68,400°
			Dif.	− 7,400°
β-Methyl-3-methyl-4,6-ethylidene glucoside	Cupra	− 128°		− 30,200°
	Water	− 126°		− 29,700°
			Dif.	− 500°

* The Hg blue line (436 mμ) was isolated for aqueous solutions by use of Corning filters 511 and 038. For cuprammonium solutions it is only necessary to use filter 038 since the longer wave-lengths are absorbed by the solution.

† The cuprammonium hydroxide solution contained 15 gm copper, 240 gm. ammonia, and 1 gm sucrose per liter. All observations on cuprammonium solutions were made in an 0.5 dm tube. The rotation of the solvent was + 0.09° (0.5 dm).

‡ It is impossible to give a correct figure for the rotation of cellulose in water solution. The present value was obtained by dissolving acid-treated cotton fiber in Triton B and diluting with an equal volume of water. Triton B is an aqueous solution of trimethyl benzyl ammonium hydroxide supplied by Röhm and Haas Company, Inc.

When positions 2 and 4 of a methylglucoside are substituted the levo-rotating complex is not formed, indicating that a free hydroxyl group on position 2 is essential for the complex formation. Likewise when positions 3, 4 and 6 are substituted the levo-rotatory complex is not formed indicating that a free hydroxyl group on position 3 is also essential. Formation of the levo-rotatory complex in glucopyranosides appears to require that hydroxyl groups on carbon atoms 2 and 3 be free while that on 4 must be substituted. It is immaterial whether position 6 be free or substituted. Finally the possibility that the complex involves linkage of the 2 position of one glucoside molecule with the 3 position of another was investigated. A solution containing equal parts of 2,4- and 3,4,6-substituted glucosides dissolved in cuprammonium hydroxide solution showed no indication of complex formation.

All the glucose derivatives considered in this communication are believed to have the pyranoside structure. Since the magnitude of the optical rotation in cuprammonium hydroxide solution is dependent upon the relationship between concentration of copper and carbohydrate, all observations were made on approximately 0.03 Molar glucoside solutions or 0.5 per cent. cellulose solutions. Aqueous solutions of similar concentration were employed. A description of the synthesis and properties of β-methyl-3-methyl-4,6-ethylidene glucoside as well as observations on the optical rotation of other polysaccharides and substituted glucosides will be published in another communication.

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[1] "Natural and Synthetic High Polymers," p. 291. By Kurt H Meyer. Interscience Publishers, Incorporated, New York, 1942.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A STILL FOR THE CONTINUOUS PRODUCTION OF DOUBLE DISTILLED WATER

This apparatus has been used for the production of all-glass distilled water for over a year and has proved very efficient. The water level in the distilling flask is maintained by means of a simple float valve made from a cork and a rectangular brass rod about 1 cm wide and 2 mm thick. This is faced at one end with a piece of gum rubber about 3 mm thick. A weather-stripping cement[1] is used to fasten the rubber to the brass. This is hinged so that when the large cork is horizontal the inlet tube (a quarter inch brass tube) is closed. The box *A* for the leveling device is made from ⅛ inch brass plates. The distillation flask

[1] 3 M weatherstrip cement sold by Minnesota Mining and Manufacturing Company, St. Paul, Minn.

E is made from a Pyrex 2 liter flask which has a 24/40 ground glass joint *D* sealed into it. The tubing sealed

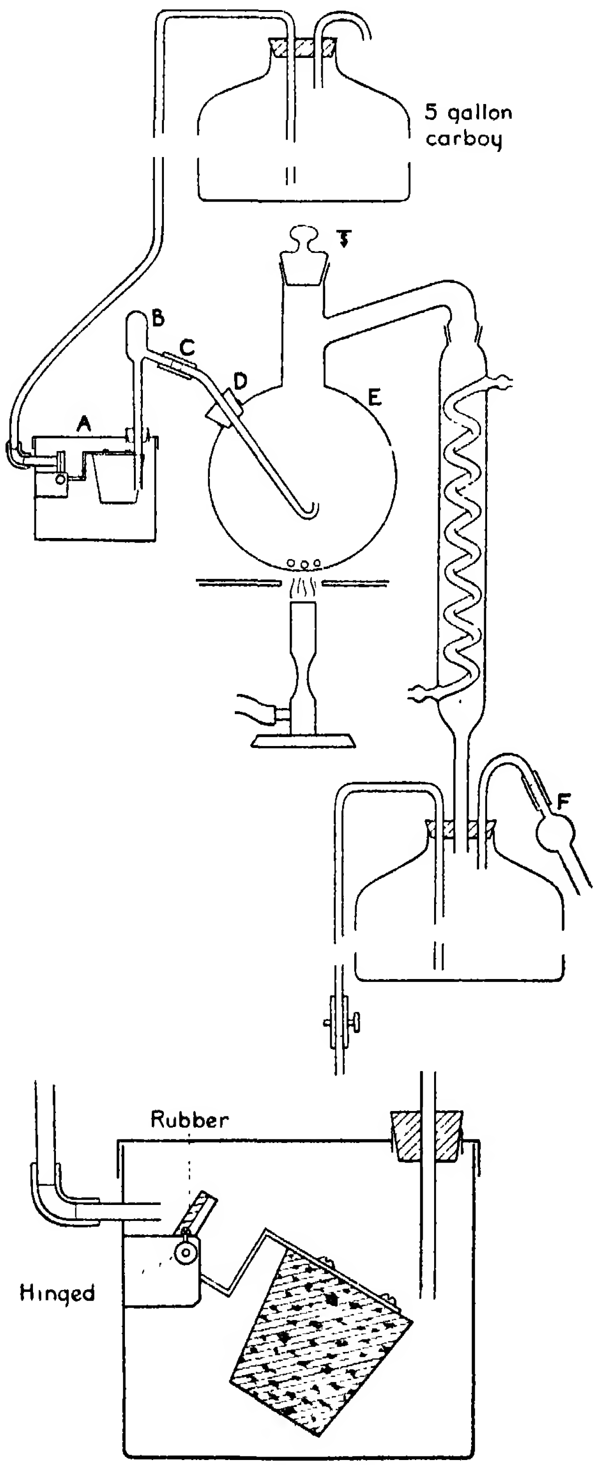

Fig. 1

into the male part of the joint should be constricted slightly at the bottom and turned up to prevent the ingress of air bubbles during boiling. The siphon is equipped with an air trap. It is made by sealing a side arm into the bulb of a broken 10 ml pipette; the upper part of the bulb is sealed. The siphon tube should be sloped from the bulb into the flask so that if any bubbles form they will collect in *B*. Over a period of months only a small amount of air collects in *B*. The rubber tubing *C* should permit the insertion of a clamp when the apparatus is not in use. The soda lime tube *F* should contain only coarse particles; otherwise it offers too much resistance to the distillation and may blow the stopper out of the flask. Sometimes it is advisable to remove the soda lime tube during the distillation.

Two mls of 85 per cent. phosphoric acid and a few glass beads are put into the flask. A Day pinch clamp is left on the rubber tubing at *C* until the water starts to boil. The siphon can be filled from the rubber tubing on the end of the delivery tube from the large carboy. When the siphon and the air trap *B* are filled, the clamp is put on at *C*. When the first distillation is started the flask *E* should be filled to a level a little below that in *A*; otherwise when the water starts to boil it will force some of the solution out of the flask into the leveling box.

The entire apparatus can be assembled in an area $24 \times 15 \times 65$ inches, which includes a 5-gallon carboy reservoir for single distilled water. Where there is a supply of running distilled water, a line can be brought over to the 5-gallon carboy and so facilitate filling the reservoir. The carboy rests on a shelf supported by wall brackets and a ⅝ inch pipe which serves as a support for the rest of the equipment.

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BOOKS RECEIVED

Grant, J. C. Boileau. *An Atlas of Anatomy.* Volume II. Illustrated. Pp. xv + 184. Williams and Wilkins Company. $5.00.

Johnson, William H. and Louis V. Newkirk. *The Electrical Crafts.* Illustrated. Pp. vii + 146. Macmillan Company. $2.50.

Lipschutz, Alejandro. *La Organizacion de la Universidad y la Investigacion Cientifica.* Pp. 216. Editorial Nascimento, Santiago, Chile.

Olson, Harry F. *Dynamical Analogies.* Illustrated. Pp. xi + 196. D. Van Nostrand Company, Inc.

Physics. Three Parts—"Mechanics," "Heat, Sound and Light" and "Electricity." Illustrated. Pp. xxvi + 1314. Henry Holt and Company. $4.50 a set. $1.50 each.

Taliaferro, William H. *Medicine and the War.* Illustrated. Pp. vii + 193. The University of Chicago Press. $2.00.

Woodbury, David O. *Beloved Scientist, Elihu Thomson.* Illustrated. Pp. xiii + 358. McGraw-Hill Book Company. $3.50.

SCIENCE

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JAMES McKEEN CATTELL—IN MEMORIAM

ORGANIZER OF AMERICAN SCIENCE

By Dr. EDWIN G. CONKLIN

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THE measure of a man's influence on science in his own and future generations may be taken (1) by his personal contributions to knowledge in his chosen field and (2) by his contributions to the organization of agencies, facilities and institutions which serve to coordinate and implement the labors of others. The former may be called his individual, the latter his social contributions to the advancement of science. Measured by either of these scales the work of J. McKeen Cattell was very important. His work began and his reputation was made with detailed work in experimental psychology. For ten years from 1885 to 1895 his published work was limited to researches in this field and resulted in more than thirty contributions from the psychological laboratory. Throughout his long life he maintained active interest in psychological research and its influence permeated all his later work.

The social aspect of his work, represented by the organization of science and scientists, had its rise and center in his work as editor and publisher of scientific journals and the opportunities which this brought him. The weekly journal SCIENCE, which he acquired in 1894, became under his ownership and editorial management one of the most important factors in the organization of science in America. A brief review of the earlier and later history of this journal will indicate the nature of the problem which it posed and the splendid way in which Cattell met it.

Science, An Illustrated Journal published weekly, was started in 1883 and was published first at Cambridge, Mass., by The Science Company. I have found no statement of the persons composing this company, but it is known that Alexander Graham Bell and one other person gave it large financial support. From 1883 to 1885 S. H. Scudder was editor and N. D. C. Hodges assistant editor. From 1885 until 1894, when its publication suddenly ceased, N. D. C. Hodges served as editor and his name replaces that of The Science Company on the title page, indicating that he was the owner. Volumes I to IX appeared in a format similar to that of *Nature*, with

28 pages of text and 4 cover pages in each number, and with many illustrations. Beginning with Vol. X, July, 1887, it appeared in a larger format of 16 pages and the subscription price was reduced from $5.00 to $3.50 per volume.

There are many evidences in these later years that the publisher was having financial difficulties. In addition to economics in format and production there were many attempts to increase circulation. In the issue for October 14, 1892, the following announcement was made:

SCIENCE owes its existence to the munificence of two gentlemen, whose names we do not feel at liberty to publish, who contributed very nearly $100,000 toward the support of the paper in its early years. There is no longer need of such liberal subsidizing, but we do need cash subscriptions from all who feel at all interested in a weekly journal of science in America.

Again in the issue of December 16, 1892, this announcement appears:

There is at present much more material offering for publication in SCIENCE than can be used so long as the paper remains at its present size. It now rests with the scientific public whether the size of the paper shall be doubled and the price raised from $3.50 to $6.00. (Blank forms of subscription, with club rates of four subscriptions for $20 follow.)

In the issue of January 6, 1893, the following announcement appeared:

The enlargement of *Science* by doubling the number of pages will have to be indefinitely postponed as the result of our efforts for three months to get eight hundred new subscribers, at the proposed increased price, has been too small to justify our going to further expense.

In the same issue this optimistic announcement is made:

More than one thousand of the leading scientific men and women of America and Europe have agreed to contribute to the paper during the coming years; and as others are constantly joining in this move to make the paper more valuable than ever, it cannot be long before there will be over two thousand competent users of this weekly medium of scientific discussion.

But in spite of the contributions of this large number of scientists the journal was a financial failure and with the issue of March 23, 1894, it suddenly ceased to appear. Its failure, as we now see, was due largely to lack of proper organization of support among American scientists and scientific societies. At this opportune time Dr. Cattell, who was newly established as head of the department of psychology at Columbia University, acquired title to SCIENCE and set about securing the cooperation of leading men of science in America in the support of a new series of SCIENCE.

The first issue of this new series appeared January 4, 1895, with the support of an editorial committee consisting of eighteen of the first-rank scientists of America representing as many different fields. The leading article of two columns was by Simon Newcomb, recognized dean of American scientists. It begins:

After a brief period of suspension this journal again appears, greeting its readers with the compliments of the season. The interest in its future which has been shown in various quarters during the last few months, convinces its editorial staff that there is room for a journal devoted to the promotion of intercourse among those interested in the study of nature. . . . The experience of centuries shows that great success in advancing scientific knowledge cannot be expected even from the most gifted men, so long as they remain isolated. . . . We need a broader sympathy and easier communication between widely separated men in every part of the country. Our journal aims to supply the want of such a medium, and asks the aid of all concerned in making its efforts successful.

President Gilman, of the Johns Hopkins University, follows with an article entitled, *"Scriptoribus et lectoribus, Salutem,"* in which he points out the ideals which should be kept in mind in the conduct of SCIENCE. Then comes the introductory address of Daniel G. Brinton, president of the American Association for the Advancement of Science, the notable address of G. Brown Goode as retiring president of the Philosophical Society of Washington, papers by T. C. Mendenhall, J. W. Powell, C. Hart Merriam and Samuel H. Scudder—all indicative of the fact that the editorial committee was taking an active part in the new SCIENCE. Reviews, Notes, Meetings of Societies and Academies, Scientific Journals and New Books are listed and all appear in the attractive format with which we have become familiar during the past fifty years. The new SCIENCE was a thoroughly cooperative enterprise, the name of J. McKeen Cattell appearing only as one of the editorial committee and as "responsible editor," in instructions to authors. But it is plainly evident that all this cooperation had been brought about by the labors of Cattell.

It is also evident that it took money, courage and high ideals to convert the financial failure of the old SCIENCE into the eminent success of the new. It was carried on at a financial loss for several years, but by hard labor on the part of Dr. and Mrs. Cattell and by its growing importance as a means of rapid publication of reports of scientific societies and of scientific discoveries and news it soon became the leading scientific publication of America.

The cooperation between SCIENCE and the American Association for the Advancement of Science has been of the greatest value to each of these. In a notable

article on "The Organization of Scientific Men" first published by Cattell in *The Scientific Monthly* for 1922, and again reprinted by him as one of his last publications, he wrote: "The American Association for the Advancement of Science has made notable progress beyond the similar associations of other nations by the support of a weekly official journal and by affiliation with the national societies devoted to the different sciences."

At the meeting of the American Association for the Advancement of Science in New York in June, 1900, it was reported that "many members do not think that they receive an adequate return for their dues" of $3. "The Council then decided to send SCIENCE free of charge to all members of the Association next year, and to publish in it the official notices and proceedings. This action will increase the membership of the Association and the interest of its members in its work, while at the same time extending the influence of the journal and promoting the cause to which both the Association and the journal are devoted—the advancement and diffusion of science." There is no doubt that this bold and at first costly arrangement on the part of both the Association and SCIENCE had precisely the effect anticipated, and out of it grew the provision that has long been in force that members of the association may receive SCIENCE for $3 per year.

Following this New York meeting the American Association for the Advancement of Science proposed that the week between Christmas and New Year's Day be recognized by all the national scientific societies as "Convocation Week" and that as many of these societies as found it desirable to do so should meet with the American Association for the Advancement of Science during that week. This was approved by seventeen of the national scientific societies and by thirty-four universities and scientific institutions, and the first great convocation of these societies and the American Association for the Advancement of Science was held in Washington in the Christmas holidays of 1903.

In all this cooperation between the American Association for the Advancement of Science and SCIENCE and between the Association and other national societies Cattell took the leading part. The Association with its affiliated and associated societies is now the largest scientific organization in the world and from the beginning of the new series the reports of the meetings of these national societies has occupied a large place in SCIENCE. Many who took part in these meetings will remember how constantly Cattell was present and how urgently he invited authors of good papers to submit them for publication in one or another of his journals.

Cattell was one of the first of American scientists to recognize the great power of the press in the promotion of science and to provide the means for such publication. With J. Mark Baldwin he founded the *Psychological Review* in 1894. He was also a founder of the *Archives of Psychology* and the *Journal of Philosophy, Psychology and Scientific Methods*. His success with SCIENCE led him to take over in 1900 the ownership and editorial supervision of the *Popular Science Monthly*, which had been established by E. L. Youmans in 1872 and which was in need of rejuvenation; its title was changed in 1915 to *The Scientific Monthly*. In 1907 he assumed control of *The American Naturalist*, which had been in active operation since 1867, but which was in danger of passing out of existence. In 1915 he founded the weekly journal *School and Society*, and conducted it as one of the leading journals of education until it was sold to the Society for the Advancement of Education, W. C. Bagley, editor, in recent years. He was a trustee of Science Service from its foundation until his death and was president of its board of trustees from 1928 to 1937. In 1906 he published the first edition of "American Men of Science," which was followed by second, third, fourth, fifth and sixth editions in 1910, 1921, 1927, 1933 and 1938. A seventh edition is now ready for the press. A companion directory entitled "Leaders in Education" was published in 1932 and a second edition in 1941. All these publications were issued from The Science Press Printing Company, Lancaster, Pa., which Cattell established in 1923 and of which he was president.

He was the responsible editor of all these publications while they were under his management, but in many of them he had an active board of associate editors, and always a silent but potent partner in his wife, Josephine Owen Cattell, while some of his children were associated with him in this work in his later years. In the Cattell home or office certain days in every week were devoted to this editorial work, one or more days being sacred to SCIENCE, others to *School and Society*, etc. Even in vacation this routine could not be relaxed, as many persons at Woods Hole found during the two summers the Cattells spent there.

Dr. Cattell was not only a great organizer of scientific publications and societies but he was also a great democrat and a bold and unyielding fighter for the rights of the common man. His organizations were based on democratic principles and he was unsparing in his criticisms of organizations and foundations that were handed down to the workers in science, education or society in general. He held that the rights of workers must be secured and safeguarded by the organization of the workers themselves. He regarded this democratic organization of scientific men as one of the greatest needs of the age. "There is scarcely any group," he said, "that has been so

backward in democratic organization as men of science; there is no other in which conditions make the right kind of organization more necessary. . . . Science has not only supplied the economic basis for our civilization; it has not only made economic slavery wanton and intolerable; it has freed us from superstition and unreason; it is in itself the most perfect art and the best religion, the force not ourselves that makes for truth and righteousness."

He maintained that the workers in science should share in the profits of their own discoveries and he strongly favored the taking out of patents on scientific discoveries, so that profit might go for the promotion of research rather than for the enrichment of capitalists. In 1921 he organized the Psychological Corporation for the purpose of selling the services of psychology and psychologists to the public—all income and profits to be used for the promotion of psychological research. He always stood firmly for the rights of the workers in any field and against those persons and agencies that would exploit the workers.

His criticisms of university organizations which placed great power over professors in the hands of deans, presidents and trustees was unsparing. He wrote, "The department or group should name its head and those to be added to it. The teachers or professors should name their deans and their president should be responsible to them. The trustees should be trustees, not regents or directors." In 1912, 1913 and again in 1914 he proposed that there be organized "an American Association of University Professors, similar to the medical and bar associations, which would be an influential force in improving the conditions under which our work is done," and he later took an active part in founding and promoting this association.

He feared "the Greeks bearing gifts and then taking them away," and he did not hesitate to criticise severely the policy of the Carnegie Foundation for the Advancement of Teaching, pointing out that the income of that Foundation would not be sufficient to pension, on the plan first proposed, the retiring professors in a single large university at the end of forty years. His estimates were later found to be much more nearly accurate than those of the actuaries who had advised the Foundation.

He always had the courage of his convictions and did not hesitate to advocate any action he considered right or to condemn any he thought wrong, however unpopular his position might be. This quality sometimes got him into trouble with university or public authorities, but he was so generally right that he usually won his fight in the end. He occupied a unique position among American men of science and he did more than any other man of his generation to bring about the organization of science in America.

CONTRIBUTIONS TO PSYCHOLOGY AND EDUCATION

By Dr. EDWARD L. THORNDIKE

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CATTELL graduated from college in 1880. From then until 1894, when he became editor of SCIENCE, his life was devoted exclusively to study, teaching and research in psychology. In those years he made and published important contributions on psycho-physics, reaction time, perception and association. Much of his work during this period consisted in doing what other psychologists had done, but with more ingenuity, precision and wisdom. He was notably successful in exposing artificialities, pedantries and loose thinking in the work of others and avoiding them in his own. He also opened up new lines of psychological investigation. Among these was the adequate treatment of individual differences in mental abilities, propensities and forms of behavior. Galton had already shown the importance of such differences, but psychologists still tended in general to hide human diversities in averages or even to discard them before computing the averages. In his very first published research, Cattell exemplified the proper treatment of them. In his paper of 1890 on "Mental Tests and Measurements" and in the systematic collection of measurements of individuals begun at Pennsylvania and continued at Columbia, he led the way in what has become a very large part of psychology. His abilities and achievements won early recognition in the form of a professorship in the University of Pennsylvania at the age of twenty-eight, the headship of the department of psychology at Columbia at thirty-one, and the presidency of the American Psychological Association at thirty-five.

In the ten years after his assumption of editorial and financial responsibility for SCIENCE, Cattell was a thorough student of psychology and a competent guide to investigators in the Columbia laboratory; but he relaxed his own investigations and his original contributions were limited to two reports: "On Relations of Time and Space in Vision" in 1900 and "The Time of Perception as a Measure of Differences in Intensity" in 1902. From 1905 on he was increasingly a man of

science in general rather than of any one science, an editor rather than an experimenter, an organizer and manager rather than a student.

It is interesting to speculate on what would have happened if he had stuck as closely to psychology as his teacher Wundt did in Germany or his friend and contemporary, Jastrow, did in America. I think that the methods of experimental psychology, educational psychology and social psychology would have been sounder and that their progress would have been along somewhat more desirable lines than has been the case. At the turn of the century Cattell was by far the most likely candidate for active leadership in American psychology. If he had been such an active leader for thirty years or more, certain schools of psychology might well have been less bigoted and many individuals saved from one or another pedantry or folly.

He chose to become both a leader and a servant, and of American science as a whole rather than of only psychology. And nobody should regret his decision. Take only one aspect of his work—the provision of an impartial journal in which for a half century any reputable man of science could set forth any honest opinion about any matter of importance to science, from the most specialized and technical to the most general or controversial—and ask what services as a psychologist could have equalled that.

During the last half of his life Professor Cattell's investigations in psychology consisted chiefly of certain measurements taken of himself, and not yet published and of statistical studies of the data gathered for successive editions of "American Men of Science." He resigned from co-editorship of the *Psychological Review* in 1904. He did not cease to be a psychologist, even after he was the editor and publisher of four important periodicals, two of them weeklies, but his leadership was in psychological affairs rather than in psychological thought and experimentation.

He was made president of the International Congress of Psychology held in this country in 1929. In 1921 he founded the Psychological Corporation, a unique organization to promote applied psychology, and was its president for many years and later the chairman of its board of directors.[1]

Cattell believed in the possibility of a science of education and was on the lookout for educational implications in his experiments on perception, association and individual differences. He had theories about the educative process, notably the theory that a home with many children of different ages was in certain respects superior to a classroom filled with children as nearly alike as possible. He had pronounced views about the management of universities, as shown in his volume of 1913 on "University Control." His most valued work for education was as organizer and editor. He induced the American Association for the Advancement of Science to establish the Section on Education, and worked to make it a success. He devoted much time and thought to the better education of the public in matters of science through the newspapers, in connection with the administration of the Scripps bequest, and was the president of Science Service from 1928 to 1937. In 1915 he founded *School and Society* as a dignified weekly journal for education in all its aspects, was its owner and editor until a few years ago, and arranged for its continuance under suitable auspices.

AS I KNEW HIM IN THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

By Dr. BURTON E. LIVINGSTON

THE devoted interest of J. McKeen Cattell in the organization of men and women of science in this country and Canada entered upon a new phase through the reorganization of the American Association at the end of the year 1919, when the present constitution of the association was ratified at the third St. Louis meeting. That constitution had been prepared by J. McKeen Cattell, E. L. Nichols, H. L. Fairchild and D. T. MacDougal. Among other innovations then introduced, the Executive Committee of the Council was established, virtually replacing the earlier Committee on Policy and the General Committee. To the Executive Committee was allocated a large degree of influence and power. In the years since its organization it has executed commitments from the Association Council, has made recommendations to the Council and has acted legally for the Council in making many important decisions in the interims between association meetings, when the prime body could not take action. Cattell was an influential member of the new committee from its beginning in the spring of 1920 and he became its permanent chairman in 1925, continuing in that office till his resignation in 1941.

[1] A more adequate account of Cattell's work as a psychologist will be found (a) in an article by R. S. Woodworth which will appear soon in the *Psychological Review*, and (b) in a number of the *Archives of Psychology* (No. 30, April, 1914) entitled, "The Psychological Researches of James McKeen Cattell," prepared by his pupils to celebrate his completion of twenty-five years of service as professor of psychology.

At the committee's meeting in the spring of 1925 Cattell was elected to be its permanent chairman and he continued in that office till his resignation in 1941. Reelected from term to term by the Council, he served on the committee for twenty-four years, being its chairman throughout all but the first five and the last three of those years. My own membership in the committee has been continuous since that St. Louis meeting, first as Permanent Secretary, then as General Secretary and afterwards as an elected member. It was indeed a great and pleasant privilege to work with Cattell during such a long period, in a field of service that always lay close to his heart. I think I came to know him well as our friendship developed and the association grew and prospered.

My intimate acquaintance with Cattell and with the reaction patterns of his mind really began with an hours-long conversation on a railway train as we were returning east after the close of the third St. Louis meeting. That conversation was occasioned mainly by my recent agreement to undertake the permanent secretaryship, to be effective about a month later. At a breakfast conference on January 2, 1920, I had been officially notified of my election to that office, by a special committee consisting of Simon Flexner, A. A. Noyes and J. McKeen Cattell. I was to succeed Dr. L. O. Howard, who had been Permanent Secretary for twenty-seven very successful and eventful years of the association's continued growth and who had been elected president for 1920. Cattell was already an elder statesman of great influence in our organization and I was the merest of tyros in association affairs.

Knowing quite well my need for information and advice, I asked many questions, both of fact and of judgment, to which he responded with helpful and enlightening replies. A pleasant degree of intimacy was implied by his prompt request that his title of "Dr." be omitted in our talks and correspondence; "Livingston, I wish you'd call me just Cattell." He dwelt on the great present importance of the methods of science in human thought and their still greater promise for future national culture. He insisted that this new job of mine would present an invaluable opportunity to aid in furthering the advance and spread of science by means of such a broad organization as the association was coming to be. Then and in later conversations, as well as in many remarks and comments that he made at sessions of the Executive Committee in after years, Cattell's ever-present wish was for human progress through science in its broadest sense; the association was to be a powerful means toward that end, but its activities should never be allowed to hinder the efforts of individuals and other societies that were working in that same general direction. To scientific societies and institutions the association was to offer help and cooperation without competition.

As chairman of the Executive Committee, year after year, Cattell showed several remarkable characteristics of mind and method. Early in each session he would bring up a question concerning the prospective hour of adjournment, so that we might complete the program of agenda without undue haste at any point. He generally took active part in the discussions, but frequently allowed the comments of others to precede any definite statement of his own attitude on a debated question. He was usually able to integrate the several positions indicated in a discussion, when there was some degree of disagreement, in such scholarly and convincing manner that the final vote had to be announced as unanimous, without any dissent. As the years went by, I think he became increasingly pleased with the long series of unanimous actions taken by the committee.

Another memorable personal characteristic of Cattell's was his natural inclination to enliven committee sessions as well as conversations with *obiter dicta* of interesting or amusing comments, anecdotes or scholarly jokes, which always seemed well chosen for the current discussions that they momentarily interrupted. He always encouraged and invited others to take part in such digressions. One usually came away from those sessions with pleasant lighter recollections as well as with the feeling that the serious business in hand had been very satisfactorily transacted without too laborious insistence on always holding to the point. On the other hand, in less convivial or more intense moods one sometimes had the impression that some portion of the time devoted to a session seemed to have been "wasted." Possible grounds for such a thought were not unappreciated by our chairman, who would call us back to serious business after each short diversion.

Consistent leadership by some one who had the association and its broad objects constantly in mind at all times was clearly needed, and Cattell supplied that need to the best of his very great capacity and opportunity. As publisher and editor of the two association journals, SCIENCE and *The Scientific Monthly*, and of his other journals, as a leader in the organization and development of Science Service, as a member of the National Academy of Sciences and many other scientific organizations, as an almost regular attendant at many of the principal scientific meetings in this country, and as originator, editor and publisher of the very useful biographical volumes of "American Men of Science"—through these various relations he became well acquainted with a very large number of American scientists. In many instances he perhaps

knew their attributes and accomplishments even better than they knew themselves. When an important science position was to be filled by appointment or election, Cattell was often called upon for suggestions and appraisals. On the basis of his judgment, at least in great part, were selected all four of the permanent secretaries of the association who have taken office through Council election since the present constitution was ratified in 1919. In some ways he became a sort of benevolent patriarch, as it were, of American science clans.

As every one knows, the longer any person occupies a position of great trust and responsibility in a democratically organized group or society, the more numerous and audible are criticisms of his performance likely to become. Rarely within the Executive Committee, but perhaps less rarely and sometimes more audibly among the other members of the association Council, complaints began to be occasionally heard that Cattell seemed to be "running the Association." Such complaints were generally no more than reflections of the obverse of his devoted personal interest and uniformly well-thought-out judgments for the welfare and growth of the organization. With regard to association aims and policies and the general conduct of its affairs he often had strong convictions, but whenever uncertainties or disagreements were frankly brought out by his colleagues he was always ready to help us reach a satisfactory compromise before discussion ended. Despite his own clear views, we found him always open-minded and democratic over all and in the long run. It is significant that he was repeatedly returned by Council election to membership in the Executive Committee. Excepting for the single year (1924) when, as president, he was an *ex officio* member of the committee, he was always one of its eight elected members.

With rapid development of the special sciences and the organization of more and more special science societies, the original strength of the association and its sections seems to have been somewhat threatened, whether generally realized or not, in a period just before the ratification of the new constitution. I think we may recognize the ingenuity of Cattell in the new provisions for the present official affiliation of independent societies, instead of the looser affiliation of earlier years. Since 1920, each affiliated society or affiliated academy of science is a part of the association, partaking in its control through elected representation in the association Council but without any loss of its own independence. That arrangement has proved highly satisfactory; it surely tended to stem any threat of disintegration that may have existed.

Cattell's activities in editing and publishing the weekly journal Science, *The Scientific Monthly*, "American Men of Science" and his other publications, constituted a very great and lasting general contribution toward the advancement of science in this country and toward the spread of scientific knowledge among the people. Those very successful private business enterprises have long been closely related to the American Association, since the Council made Science the association's official journal in 1900 and gave similar status to the *Monthly* in 1909. The growing lists of "American Men of Science," so laboriously compiled and so finely edited under Cattell's direction, have been most valuable to our organization in the selection of names for nomination to association fellowship, and in the naming of association committees.

Business relations between the association and Cattell concerning the editing and publishing of the two journals just mentioned were not wholly free from discordant notes, for the association had agreed to his retention of ownership and managing editorship without any arrangements for effective association control or any formal democratic influence in the conduct of the journals. The association could purchase subscriptions for its members at a wholesale rate, but it was constrained to accept whatever editorial and management policies seemed best to the owner It was fortunate that Cattell's policies were generally so nearly in line with the aims of the association, and the arrangement resulted in obviously very great benefit to science workers and the association as well as to the publisher. They constituted an excellent bargain for both sides; for at that time the association found itself in no position to undertake the complex responsibilities of publishing a journal of its own, the journals offered were already successfully going concerns of the sort needed, and, in turn, they were greatly benefited by this form of association support.

Those were friendly agreements, adhered to for many years; but some difficulties arose, especially in connection with the official journal, which could of course be truly official only in a limited and special sense under the conditions agreed upon. For example, when the Washington office submitted notes and reports for publication in Science, final decisions as to their acceptance were in the hands of a single person, in whom were vested all the prerogatives of editor, publisher and owner. There was no possible recourse to any democratically constituted editorial board or other authoritative publication committee of the association. Other difficulties arose, but compromises were usually reached.

It is not hard to appreciate Cattell's dilemma, which was natural enough, with regard to the future of Science and the *Monthly*. He wished devotedly to aid science and the association, but at the same time he was driven to seek protection for his successful

publication business and his personal financial estate. When he offered to sell the journals to the association on his retirement, he hoped to accomplish both desires at once. His proposals seemed fair to the Executive Committee and the association Council, which accepted them with expressions of appreciation and ordered them signed and duly sealed. Further study and clarification of those proposals led to a revised and more detailed agreement, which was also accepted and duly signed by both parties. Questions persisted, however, not only in the minds of many association members but also in Cattell's mind, as to whether the final signed agreement really embodied all that was desirable on both sides. In conversation he once said to me that he would be willing to consider cancelling the agreement if the association should propose that solution. But no action was taken. The second agreement was in part fulfilled when *The Scientific Monthly* was purchased by the association, and the remaining part still stands, providing for the ultimate purchase of SCIENCE.

I am convinced that Cattell's original intention, in proposing that these journals should ultimately become solely the responsibility of the association, was to make a very fine gift to the organization and to American science workers. He regarded the specified terms of sale as a not too burdensome condition for such a gift. However that may be, those terms were definitely accepted by the association and they were adhered to in the recent purchase of *The Scientific Monthly*, which is now edited, published and managed, with evident success and great promise, by the staff of the association's Washington office. There can be no doubt that both association journals will be carried forward into the approaching new era of science advancement and that they will forever constitute a remarkable monument to one far-reaching aspect of Cattell's many achievements.

HIS SERVICE TO SCIENCE

By Dr. ANTON J. CARLSON
UNIVERSITY OF CHICAGO

BY the *diversity, duration* and *character* of Dr. Cattell's services to science our departed colleague has earned an enduring place in our hearts and in the history of American science. His services as president of our association are the least significant. Others more competent will speak of his many years and his great influence in the council and in the executive committee of the association. Dr. Cattell became the editor and publisher of SCIENCE fifty years ago. The character of that journal and its service to research and to education in science, we owe largely to that one man. That he had sufficient business acumen, foresight and energy to make SCIENCE, *The Scientific Monthly, School and Society* and his other publication projects carry on without subsidies, and succeed financially through their own merit, is additional evidence of Dr. Cattell's capacity and his faith in his fellow men. In these days of increasing specialization, our weekly journal, SCIENCE, has served and should increasingly serve to keep all of us somewhat in touch with progress and failure in all fields, and thus, discourage the development of the delusion that "what I am doing is the only work worth while."

The Scientific Monthly endeavors to present, in lay language, the significant problems and findings in special fields of science. Perhaps we should now take stock and inquire whether to-morrow we should, both in SCIENCE and *The Scientific Monthly*, present more regularly and clearly the method or methods yielding our new facts and our larger generalizations. In "American Men of Science," Dr. Cattell initiated an inquiring look at the human variant called the scientist.

The passing of a colleague who rendered conspicuous service to science and society for sixty years compels those still in harness to pause and ponder. From the point of view of physics and chemistry the individual man is an insignificant clod in the common worldstuff. We in biology find this clod a challenging problem. What makes this clod click? What makes one man perform better than some of his fellows? The answer is still largely out yonder, in the unknown processes of living matter. We salute heredity and scan the environment, and yet we do not know. In his maturing youth our departed colleague was a student at the Johns Hopkins University, at Leipzig, at Göttingen, at Paris and at Geneva. In those days the Johns Hopkins University was up and coming, science in Germany lighted the entire civilized world, and the German university was the mecca for the budding American scholar. Cattell's brief sojourn at Bryn Mawr College and at the University of Pennsylvania should probably also be counted in as part of his Wanderjahre and of some significance in the making of the man—James McKeen Cattell.

I knew, though not intimately, our departed colleague for some forty years. Three elements in his character stood out, according to my observation: First, his broad interest, sound judgment, and wisdom; second, his extraordinary energy and capacity to

work; third, his conspicuous courage. All three were undoubtedly significant in his outstanding service to science during the last fifty years and his attempt to make science understood and therefore effective in the ways of life of our non-scientific fellow citizens.

A word about the Cattell courage. Some colleagues probably would term it stubbornness. Yes, Dr. Cattell was at times stubborn. He might have been less insistent had all the facts in the issue been clearly known. But, in my experience, dogmatism did not obscure Dr. Cattell's vision for long, not for days or years. His was a mind unusually open and inquiring. But he never compromised on what he considered established facts, probable reason based on facts and on fundamental justice and fair play. When Columbia University dismissed Dr. Cattell from his professorship in 1917, during the mass hysteria of World War I, dismissed him on the charge of treason, because he as a plain citizen had signed a petition urging Congress not to declare war, Dr. Cattell did not take that lying down. A man or woman really loyal to science can not be false to any man or any country governed by the principles prevailing in our own beloved land. At this juncture, Dr. Cattell displayed some of the courage of Galileo, who, when condemned on his facts by the prophets of superstition, still insisted that "the earth does move."

Dr. Cattell's worthwhile labors will endure only if we, on taking stock, discover the wisdom, the vision and the courage to carry on. What are these unfinished tasks, these seemingly endless labors of Hercules? (1) The light of scientific understanding, despite our boasting, has not yet penetrated very far into the unknown night. The scientific conquest of the yet unknown in every field appears to me a more stupendous task and a more worthwhile challenge than the subduing of the other fellow with bayonets and bombs. Assuming we have or can find the brains, we could travel faster on the road towards new discoveries, did we have more intellectual, moral and financial support from society. (2) If there be a better way of securing understanding than by the method of science, human history and human experience have not yet revealed it. If this is a fact, it follows that the scientific method should be applied to all fields of human endeavor. This means that all men should have a workable understanding of it. Is that feasible? We will not know until we try, and so far we have not tried either very hard or with much persistence. Dr. Cattell made a start. We hear many words about the confusion in to-day's education. I think superficiality and triviality, rather than confusion, are our besetting sins in education. It is play in place of mastery, the "Quiz Kid" ideal of *what,* rarely proceeding to the *evidence* and the factual *why.* This is not an accusation against the other fellow. For when we examine the record, our own performance (in science education) is as yet below par. If our answer is: We can do no better with the human cerebrum against the primitive hypothalamus of man, we surrender our creed. We *can* try new devices with more persistence, if the *goal is clearly worth while.* Fortunately, we can not quit even if we want to, for human curiosity, human want and human pain are potent spurs. At present, education (even in the sciences) is largely memory conditioned by traditions and faith rather than by the exercise of reason based on understanding. But lest in these few lines about a great citizen and a great servant of science I (by partiality or exaggeration) sin against science itself, I must conclude by saying that the servants of science are not supermen. They are made out of the common human clay. And even they may at times falter in the application of their creed, which in terms of action reads: Keep your mouth shut and your pen dry till you know the facts. Use your intelligence and integrity with all diligence to get the facts. Then, and only then, can we speak with some measure of enduring wisdom as we walk humbly among our fellow men. Dr. James McKeen Cattell did not stray very often or very far from this difficult path during his sixty years of superb service to science.

RESOLUTION OF THE EXECUTIVE COMMITTEE

Whereas, The death on January 20, 1944, of J. McKeen Cattell has deprived this Executive Committee of this distinguished member:

Whose years of membership in the Committee have been continuous since its organization in 1920, and whose services to the Association began many years earlier;

Whose knowledge, comprehensive and incisive mind for so long have stimulated and guided the considerations of the Executive Committee;

Whose intelligent and constant concern about science and its services in America and throughout the world constantly expressed itself in important and far-reaching ways;

Whose exceptional organizing, business, and editorial abilities initiated and developed scientific publications and scientific organizations of surpassing scope and usefulness;

Whose personal researches and teaching produced novel and major contributions to psychological science, and trained many superior students whose contributions to science are widely known;

Whose ever-alert mind, keen judgment and frank com-

ment, when applied to the perplexities of his associates, helped many scientists to find their way more clearly through scientific and personal problems;

Whose friends, holding him in high professional respect and personal esteem, include almost all those who knew him.

Therefore, *be it resolved,*

That on this sixth day of February, 1944, we, the members of the Executive Committee of the Council of the American Association for the Advancement of Science, as the elected representatives of the Association, express to Mrs. J. McKeen Cattell and all other members of the family of Doctor J. McKeon Cattell, our appreciation of:

Doctor Cattell's unmatched services to American and International science and to scientific publications;

The privilege and good fortune in our long association with Doctor Cattell, and our sense of irreparable loss through his death

The Executive Committee expresses its sympathy with Doctor Cattell's family and with the host of other friends of this truly great American citizen, and acknowledges the obligation of this Committee and the Council of the American Association for the Advancement of Science to go forward with the great work to which Doctor Cattell devoted so much of his thought and energy throughout his long and effective life.

J. W. BARKER
OTIS W. CALDWELL
W. B. CANNON
A. J. CARLSON
ARTHUR H. COMPTON
BURTON E. LIVINGSTON
KIRTLEY F. MATHER
F. R. MOULTON
E. C. STAKMAN
W. E. WRATHER

SOME PERSONAL CHARACTERISTICS

By Dr. R. S. WOODWORTH

PROFESSOR EMERITUS OF PSYCHOLOGY, COLUMBIA UNIVERSITY

DR. CATTELL was a man of strong character and disinctive personality. He was indeed, as has been said, a "dominant figure" in many scientific circles. It would be a mistake, however, to describe him as dominant in the sense of domineering or to imply that he was eager to dominate the groups in which he played so important a part. Characteristically outspoken and free-thinking, he was nevertheless not at all inclined to jump to a hasty conclusion or to express more than a tentative opinion on doubtful questions. He was an excellent committee man and council member, as amply proved by his fifty years of constructive service in such capacities.

In the old days it was true that many of his graduate students were afraid of him, as they had need to be if their experimental work was sloppy, if they neglected the literature of their problems, or claimed far-reaching conclusions from limited data, or failed to consider the "probable error" of their results. But the sincere research student had nothing to fear from Cattell, who was all interest and helpfulness. Instead of handing out prescribed dissertation subjects he gave each student the first say in the choice of a problem and followed the student's lead if it gave any promise of accurate scientific work. In consequence a great variety of experiments went on in his laboratory, though some of the best were following up his own leads. To his advanced students and junior colleagues he was a loyal personal friend as well as a keen scientific adviser.

In an after-dinner speech before a group of friends and associates, including many of his old students, Cattell told a story of his boyhood. His mother took him for examination to a phrenologist who gave the boy a fine rating in almost every respect but added one less favorable note: "You are deficient in will power!" The spontaneous outburst of laughter from his friendly audience seemed to surprise Dr. Cattell, who probably did not regard himself as a notably strong-willed individual. He may even as a youth have accepted the phrenologist's dictum and have striven earnestly to develop his will power. As an adult he certainly showed abundant courage in undertaking large and difficult tasks, and notable energy and persistence in putting them through. But as regards this matter of dominance his attitude was not one of imposing his will on his juniors and subordinates, though it was one of resisting domination by those higher up—unless their authority was due to merit and ability rather than simply to position. The ruling classes and pillars of society, and especially university presidents and trustees were the target of pungent epigrams which he evidently took great pleasure in concocting and applying to his victims in conversation and in his speeches and writings. Addressing a Johns Hopkins group at the time of President Remsen's inauguration he said:

> As Mr. Remsen told us that the professor would be pleased, but not particularly improved, by an increase in salary, I may perhaps be permitted to suggest that a president might be pained, but would not be seriously injured, by a reduction of his salary to that of the professor.

And speaking to a Harvard group on the baffling problems of the college curriculum he said:

It is not desirable to support at public expense certain country clubs or detention hospitals in which rich boys may be segregated. . . . Thanks to heredity and opportunity combined, there are more dominant personalities, such as Mr. Theodore Roosevelt, Mr. Pierpont Morgan and Mr. Lawrence Lowell, from this small upper class than from the working millions. Whether or not we should be better off without such men is not the question. Until opportunity can be equalized we shall have them; the college must bear its share of responsibility for what they do in the world.

It irked Cattell that the support of scientific research should be dependent on the favor of administrators and politicians. Time and again he urged that it would be much more logical if a fraction of the economic gain from research should be turned back as a matter of right to the scientific fraternity for the support of further research. In founding the Psychological Corporation in 1921 his hope was—and it is being realized—that applied psychology might pay its own way and earn at least a part of the funds needed for its advancement.

Cattell's interest in children was obvious to the many friends who visited his home on the mountain in Garrison, New York, a home no more remarkable for its location and scenic outlook than for its friendly hospitality. If you took your own children with you, you soon discovered that his love for children extended beyond his own large and appealing group of youngsters. Since these children were not sent to school there were rumors afloat that they were being kept in isolation and subjected to some strange experimental sort of education. As a matter of fact, with the editorial staff working in the home, with the numerous distinguished visitors and with the superior young men brought in as tutors, these children were far from isolated; and it may be permitted to add, as against the rumors of harsh treatment and restricted educational opportunities, that these children have not done so badly and that the solidarity of the Cattell family has been remarkable through all these years.

Cattell's deep interest in child welfare and family welfare, and his skepticism regarding the value of schools as they are were clearly set forth in an article on "The School and the Family," which he published in the *Popular Science Monthly* for January, 1909. He wrote:

Mankind will last only so long as children are born and cared for; and no plausible substitute for the family has been proposed. . . . The school by its nature weakens the family, for it takes the children away from home and gives them interests not centered in the home. . . . We need most of all to make life in the country attractive and fine. . . . The country school is at present no such place. Its general tendency is not to prepare children for usefulness and happiness in country life, but rather to make them inefficient and uncomfortable there and to send those who are more clever and ambitious away to the city. And the school shares with the city the bad preeminence of being one of the principal causes now working to break up the family. . . . Can one not fancy a school in the country, the house a model of simple beauty . . . surrounded by gardens, orchards and barns? . . . In this house the children would gather . . . for some two hours a day. The master and mistress and their older children . . . would teach the tricks of reading, writing and reckoning to those who lacked them, and all would be encouraged to go as far as they cared along the paths of letters and science. Two further hours might be spent in working about the place, in the shop, in the garden or with the animals, sewing, cooking or cleaning, learning to do efficiently and economically the things that must be done. . . . Children would always be the chief concern in a home and in a school such as this. There would be no pathological, no economic, no psychological conditions at work for their extermination.

THE PSYCHOLOGICAL CORPORATION

By Dr. PAUL S. ACHILLES

ONE of Dr. Cattell's many notable achievements was the organization in 1921 of the Psychological Corporation. The launching of this unique business enterprise in the early days of applied psychology was typical of his exceptional foresight and courage. Although others realized that many of the practical applications of psychology would be of economic value, it was Cattell who took courageous and far-sighted action. He proposed that psychologists should *earn* funds for research and, accordingly, he established a business corporation, owned and operated by psychologists, not for private gain but, as stated in its charter, for "the advancement of psychology and the promotion of the useful applications of psychology." Thus he sought both to bridge the gap between psychological theory and practice and to provide that some share of the legitimate profits from practice be conserved for research and the further advancement of the science. His challenge to the few hundred recognized psychologists at the time was, "Let us mix our brains with our money," explaining that, under the aegis of a business corporation, psychologists could render many useful services to business organizations, to educational institutions and to individuals, and thereby earn funds for psychological research.

I played no part in the corporation's founding, but was fortunate in 1926 to be elected its secretary and treasurer, and have maintained my connection with

it ever since. Hence I am asked to write this note concerning the corporation, in tribute to Dr. Cattell. I do so with a special sense of affection and gratitude, for in the enterprise which he founded I found my own career, and I know that he considered one of the corporation's most valuable functions the opening of useful careers to many younger psychologists, both within its own employ and in new fields of endeavor where its pioneering work would help to develop opportunities.

From a financial standpoint, the progress of the Psychological Corporation was discouraging at the start. Its bank balance once dwindled to less than $400. I recall the days when I worked in a corner of Dr. Cattell's offices and was somewhat in awe of him, but I soon learned to appreciate the kindliness and wisdom back of his sharp, keen questioning. Between us we went into considerable debt on the corporation's behalf, but with the help of Dr. Henry C. Link and others who ventured to join the staff, or to work for the corporation with only the hope of future financial reward, sources of earned income, never subsidies, were gradually developed. By 1939, all the corporation's debts had been paid off. In 1943 its gross income was over $600,000, and its first dividend, in the amount of $2 per share, was declared by its board of directors. Of greater significance than these figures, however, has been the growth of the corporation's staff, the cooperation in its work of many psychologists and students throughout the country, and particularly the recognition it has gained for services of high standard and their practical usefulness to business organizations and to individuals.

In accordance with Dr. Cattell's aims in founding the corporation, namely, that its profits beyond limited dividends to its stockholders and reasonable compensation to those engaged in its work should be devoted to research, the corporation established in 1941 the James McKeen Cattell Grants-In-Aid of Research. Much of the corporation's work is, in itself, useful research in applied psychology done in cooperation with business organizations, but these grants-in-aid are made to graduate students and other psychologists whose independent studies seem likely to contribute valuable practical applications. Thus the corporation, both within its own sphere of work and through the investigations of psychologists elsewhere, continues to plow back an increasing share of its earnings into research.

With the same foresight and humanitarianism in later maturity that characterized his early life, Dr. Cattell established, in November, 1942, the James McKeen Cattell Fund by generous donation of his six hundred shares of the Psychological Corporation's stock. As stated in the Trust Agreement, the purposes of this Fund are to "enable the Trustees or their successors to administer such fund for scientific research and the dissemination of knowledge with the object of obtaining results beneficial to the development of the science of psychology and the advancement of the useful application of psychology." Thus, so long as the corporation is successful, its work and its dividends will contribute, as Dr. Cattell wished, to the advancement of psychology and serve to remind us of his faith both in psychology and in his fellow psychologists.

SCIENCE SERVICE

By WATSON DAVIS

IN a day when scientists were afraid and unconfident of what newspaper reporters might do to their researches through careless and inexpert exposure to the public, J. McKeen Cattell was one of the little band of American scientists who risked their reputations in an experiment that had as its purpose the popularization of science.

When the original board of trustees of Science Service was convoked in 1921, Dr. Cattell was one of the three members who represented the American Association for the Advancement of Science. He was continuously a trustee from that time until his death and his term of service is exceeded by that of only one other scientist.

For most of this time and until recent years, he was a member of the executive committee and he thus was called upon to give of his time and energy more frequently than most of the trustees. For almost half of this time he was honored with the presidency of the institution, serving from 1928 until 1937 in this office.

The public was thus taken into the broad sphere of Dr. Cattell's many interests by his participation in the upbuilding of Science Service. This constituted a fitting rounding-out of his founding of publications in various scientific fields, his periodic issuance of critical and informative biographical directories of professionals in science and education, his development of scientific organizations, his pioneering in scientific psychology and his contending for freedom of teaching.

There were few scientific committees or organizations in which Dr. Cattell participated which were not enlivened and illuminated by his comments and criticisms. When he was not with the majority, he was consistently the loyal opposition that kept the

administration self-critical and free of complacency. Science Service in its formative years benefited in this way.

Those who labored along with the staff, under the direction of Dr. Edwin E. Slosson, in those early days of science's infiltration into the daily press realized the fundamental change in attitude that came over the scientific world as the result of the operation of Science Service under the encouragement of the scientists and newspapermen on its board of trustees. Science reporting was at first merely tolerated as a necessary evil and it finally became a respectable means of informing the public and the scientific world.

Early in the operation of Science Service Dr. Cattell decided that a selection from its report to newspapers could, with benefit to the scientists who read it, be printed as a supplement to each issue of SCIENCE. One of Dr. Cattell's considerations in doing this was to call the attention of scientists to the work of Science Service. This was beneficial to Science Service, and also, presumably, to the journal.

As the example of science reporting as practiced by Science Service gave rise to the present corps of science writers on newspapers and press associations, Dr. Cattell gave his aid to the widest possible publicizing of the meetings of the American Association for the Advancement of Science in which he always played a dominant role. In a sense he was looked upon by the gallery of science writers as one of the craft.

In the foundation of Science Service, Dr. William E. Ritter worked with E. W. Scripps, the great newspaperman. Dr. Ritter was instrumental in formulating plans and winning organized scientific support for the then new venture. Dr. Ritter's death occurred on January 10, just ten days earlier than that of Dr. Cattell. Thus there were lost to science within a fortnight two of our great pioneers in taking science to the reading world.

Truly this is the end of an epoch, and the years to come will reflect their pioneering.

IN MEMORIAM

By Dr. L. O. HOWARD

I AM very glad to be asked to write for the special number of SCIENCE. I first met Cattell, I think, in 1899 at the Columbus meeting of the American Association, during my second year as permanent secretary, but I am 86 years old and I sometimes forget details. He introduced himself to me and told me he was just back from Europe, and I think that he had recently bought SCIENCE from Gardiner Hubbard and Alexander Graham Bell. He wanted me to consent to the taking over of the journal as the organ of the American Association for the Advancement of Science. I told him that it would cost too much and turned him down. But I was wrong, and he immediately talked things over with R. S. Woodward, who was then connected with the Columbia faculty and with Sedgwick Minot, then connected with the Harvard Medical College, and they formed with me the first Committee on Policy of the Association. This committee did splendid work for the Association, until it was succeeded by the Executive Committee in 1920.

Cattell was a warm friend of mine from that time on, and I owe him a very great deal. He stood by me well during the twenty-two years of my permanent secretaryship and he was largely responsible for every good thing which the association ever did. I think, all things considered, that he was the most useful member the association ever had, and when we think of the big names included among them, in saying this I have said a very great deal.

LEADER IN SCIENCE

By Dr. G. H. PARKER
HARVARD UNIVERSITY

To many of us who were a few years younger than Dr. Cattell he was a life-long example of what an unflinching, upright seeker after scientific truth should be. No toil was too great, no effort too exhausting to hold him from worthy ends. With honest simplicity and vigor of purpose he set about his many tasks of helping science to its present high position. His abilities in psychological research and his directorship of laboratories in which such research could be carried out are now matters of no small historical significance. As one who transformed the American Association for the Advancement of Science from a body of mild accomplishments to the most effective agent in the growth of the wide scientific interests in this country and abroad he will always be remembered. In this large undertaking he showed remarkable abilities as a business manager , as an editor and above all else as a protagonist for what was highest and best in a world growing rich in scientific attainments and traditions.

Always open to approach by those who needed counsel and advice he gave to them unsparingly of his time and strength. What he expressed to such as sought him out were his honest and inmost convictions spoken with unquestionable freedom and full sincerity. His views were his own. If this course sometimes made enemies for him, it made enemies who at least respected him. Personally unselfish yet tenacious of purpose, his accomplishments were always for the general good. Few recognized to the extent that he did the strong undercurrents of scientific endeavor that flow through this and all other rightly constituted nations. With unusual insight and unerring fidelity he urged forward those scientific movements that make for real human betterment and the ideals of true learning.

With a life based upon such principles no wonder that the door of opportunity was often open to him! He was early admitted to membership in the American Philosophical Society and the National Academy of Sciences. He served the American Psychological Association and the American Association for the Advancement of Science in many capacities including that of President in both organizations. His membership in other societies was wide and distinguished. Intimacy with him was a delightful experience because of his generous and kindly nature. Ready and brilliant in thought his words were a pleasure to those who gave ear to them. What he said and what he wrote had often a note of shrewdness, but it was shrewdness tempered with the best of wisdom. The achievements of his life are of lasting value. They are not the doings of an hour to pass off as quickly. They are vigorous, far-sighted movements that because of his clear intuitions and energy have gained such an impetus that they are bound to carry far into the future. Such an inheritance Cattell has left us. It is for us to see that it shall not perish.

HUMANITARIAN—A REMINISCENCE

By Dr. HENRY NORRIS RUSSELL
PRINCETON, N. J.

I HAD once an opportunity to see an aspect of Dr. Cattell's activity and character which is probably less widely known than his lifelong support of the causes in which he believed, but does him equal honor. It was on an Atlantic liner, bound for England. Two days from port, a woman in the third-class, seriously ill, who was returning with her two young children for a last visit to her parents, suffered a sudden attack and died. The stewards, doing their best to help, went about the ship with one of the weeping children, and "passed the hat," securing a few pounds for them. Dr. Cattell, hearing of this, realized that the situation demanded help—and action—on a larger scale. He drew up a statement telling how the children were left destitute and required substantial aid, and headed a subscription list with a liberal personal contribution. Next—as he told me—"I got the purser to give me a list of all the passengers who had rooms with bath, and interviewed them personally." This brought a number of contributions—some of a hundred dollars. Fortified with this he posted the subscription-list on the companion-way—amounts and all—realizing that this course would set a scale appropriate to the emergency.

His knowledge of human nature was justified. Subscriptions came in steadily; and before the ship reached Plymouth, a fund of more than a thousand dollars was ready to place in trust with the steamship company—to be applied to the children's education and welfare.

Had this been a matter of private generosity on the part of Dr. Cattell it would not be appropriate to recount it here. But the very fact that he made it a public, and thus a community matter, illustrates his sound knowledge of practical psychology, and his clear perception of the limits of the conventional rules of reticence in such matters.

He alone, of all the long passenger-list, realized the magnitude of the need. With no time for delay, he made sure of a promising start for his campaign before he launched it publicly, and he followed it to a completely successful conclusion. The little episode illustrates so well his knowledge of human nature, and his interest in human welfare, that it deserves to be recorded.

COURAGEOUS LEADER

By Dr. W. F. G. SWANN
BARTOL RESEARCH FOUNDATION, SWARTHMORE, PA.

IN the death of Professor J. McKeen Cattell, science has lost a colorful personality who, for a full lifetime, has exerted a profound influence upon American scholarship.

The man who held the world's first chair in psychology did not confine his influence to the field of his specialty, but, using his extraordinary talents and initiative for organization in the field of publication, has done a work which few could do, and this with a whole-hearted devotion to the cause which spared

neither his personal energy nor his personal fortune in its furtherance. On talking with him one could not help but be impressed by the almost reverent attitude which he adopted towards the matter of standards in connection with the publications with which he was concerned. He would not hesitate to go after the material he wanted, but when he got it, he insisted on the maintenance of standards which he had at heart.

A man of Professor Cattell's forcefulness, strong convictions, courage and personal drive might be expected to find frequent occasion for difference of opinion with others, and several such cases of public interest can be cited. Unswerving in his convictions and strong in courage, he did not weaken in the attack because the enemy might be strong. Gifted with a sense of humor, he could make his darts tell, when fired to spill the blood of what he deemed arrogance, unfairness, complacency or indifference to the good of his fellows. However, in all this, he was a man who merited and won the respect of all and the love of those who were fortunate enough to be his friends.

SCIENTIFIC EVENTS

THE GREENWICH ROYAL OBSERVATORY

The Royal Observatory, Greenwich, which was established in 1675 on its present site for the advancement of the science of navigation and nautical astronomy, as already reported in Science, may have to be moved. The naval correspondent of *The Times*, London, writes:

For over two and a half centuries it has provided the standards of navigators; to-day it gives the time to the whole world and all longitudes are measured from the meridian that passes through its transit instrument.

When it was established, Greenwich was a country village well clear of London's smoke; even in the last century, when magnetic observations were added to its duties, it was sufficiently rural to be free from disturbance. But to-day London has spread round it. Even at the end of the last century its work was much hampered by the construction of a power station from which smoke from the chimneys, sited exactly on the meridian, interfered with astronomical observations. The vibration of its reciprocating engines was also felt at the top of the hill.

The great development of electrical machinery, even in the home, compelled some years ago the removal of the magnetic observatory to a country site in Surrey. To-day interference of various kinds has become so serious that the removal of all activities that can be separated from the site on the prime meridian is being considered.

Sir Harold Spencer Jones, Astronomer Royal, pointed out that the observatory is already dispersed, partly owing to bomb damage and partly for security reasons.

A great deal of work would have to be carried out before any move could be made, and all that had been done so far was to accept, in principle, the need for a move if the observatory was to continue the valuable astronomical work it had done in the past.

There are only two alternatives—either to put up with the conditions at Greenwich and deteriorate into a second-rate institution or move away into conditions where useful work can be done.

THE INSTITUTE OF TECHNOLOGY AND PLANT INDUSTRY AT THE SOUTHERN METHODIST UNIVERSITY

The Southern Methodist University at Dallas plans to establish an Institute of Technology and Plant Industry. It will have the active participation of the National Cotton Council, which in the field of plant study and adaptation will merge its facilities with the new institute. Dr. C. L. Lundell, of the University of Michigan, has been appointed director.

The institute will include an agricultural research station, a research laboratory and a southwestern herbarium. For the agricultural research station a tract of 110 acres of land has been purchased near Renner, nine miles from the university. It will sponsor research which will bring agriculture and industry into closer relationship.

A laboratory with other necessary buildings will be erected on the farm at an early date. A chemical building is to be erected at the university. Other buildings will be added as required. An agronomist and a geneticist with several farmers and mechanics have been appointed to the staff.

Affiliation of the institute with the National Cotton Council of Memphis provides for the removal to Dallas and other strategic locations in the Southwest of its cotton production and breeding projects, in which the two research organizations will supplement each other's activities.

Under the auspices of the council and the university a plant introduction garden at Acapulco, Mexico, on the Pacific Ocean will be maintained. The council is transferring its production staff, of which Dr. Harold H. Webber, of the research division, is director, to the university. It will spend $62,000 this year for cotton research, jointly sponsored by it and by the War Production Board. Dr. Simon Williams, director of the cotton research division of the National Cotton Council, now has his headquarters at the University of Texas, where he formerly had charge of cotton research.

THE ARGENTINE CITIZENS DECLARATION

MEMBERS of the Council of the American Physiological Society have signed a statement in appreciation of the declaration recently made by one hundred and fifty distinguished citizens of Argentina. This action caused the dismissal of Bernard A. Houssay, professor of physiology at the University of Buenos Aires, and of other well-known teachers of Argentina. The letter follows:

The undersigned, members of the Council of the American Physiological Society, deplore the action of the Argentine government in dismissing from public service those persons who signed the so-called Argentine Citizens Declaration (SCIENCE, 98: 467, 1943). The one hundred and fifty men who signed that manifesto were all men of distinction in many walks of life, and included in their number the professors of physiology in the three leading medical schools of the country. By their action, they have spoken valiantly and fearlessly for the cause of democracy and intellectual freedom. We admire their spirit and congratulate them for their self-sacrificing devotion to the cause of human liberty.

As free citizens of a sister American state, we desire to express publicly our sympathy for them in their present dilemma and our concern over this implied threat to the freedom of speech in the Americas. We are confident that these views are freely shared, almost without exception, by other members of the American Physiological Society to say nothing of the one hundred and thirty million other citizens of this country.

We hope that this letter may bring to our Argentine colleagues some well-deserved moral support and encouragement in their continuing championship of the cause of democracy and freedom for the sake of which, in this instance, they have been so cruelly victimized.

PHILIP BARD
C. H. BEST
HALLOWELL DAVIS
H. E. ESSEX
WALLACE O. FENN
W. F. HAMILTON
MAURICE B. VISSCHER

AWARD OF THE WILLARD GIBBS MEDAL

DR. GEORGE O. CURME, JR., vice-president and director of research of the Carbide and Carbon Chemicals Corporation, New York, has been awarded the Willard Gibbs Medal for 1944 of the Chicago Section of the American Chemical Society. The award is bestowed annually "in recognition of eminent work in and original contributions to pure or applied chemistry."

The citation reads in part: "More than any other individual Dr. Curme is responsible for the development of the Carbide and Carbon Chemicals Corporation and for its outstanding advances in the field of aliphatic chemistry. He may well head the list of those who have brought leadership in organic chemistry from Germany to the United States, particularly in the field of aliphatic chemistry."

Dr. Curme was born in Mount Vernon, Iowa, on September 24, 1888. He received the B.S. degree from Northwestern University in 1909 and the Ph.D. from the University of Chicago in 1913. He continued his graduate studies in Berlin, and from 1914 to 1920 he was a fellow at the Mellon Institute for Industrial Research, Pittsburgh. He became chief chemist of the Carbide and Carbon Chemicals Corporation in 1920, and since 1927 has been vice-president and director of research. He received the Chandler Medal in 1933, the Perkin Medal in 1935 and the Elliott Cresson Medal in 1936. He holds the honorary degree of doctor of science from Northwestern University.

The Willard Gibbs Medal, of which Dr. Curme is the thirty-third recipient, was founded in 1911 by William A. Converse, secretary of the Chicago Section from 1901 to 1909. It was named for Josiah Willard Gibbs, from 1871 to 1903 professor of mathematical physics at Yale University. The presentation will be made at a meeting of the Chicago Section on May 24.

Previous recipients of the medal include Dr. Vladimir N. Ipatieff, Svante Arrhenius, Mme. Marie Curie, Sir James Irvine, Dr. Richard Willstätter, Theodore W. Richards, Leo H. Baekeland, Ira Remsen, Arthur A. Noyes, Willis R. Whitney, Edward W. Morley, William H. Burton, William A. Noyes, F. G. Cottrell, Julius Stieglitz, Gilbert N. Lewis, Moses Gomberg, John Jacob Abel, William D. Harkins, Claude S. Hudson, Irving Langmuir, Phoebus A. Levene, Edward C. Franklin, Harold C. Urey, Charles A. Kraus, Roger Adams, Herbert N. McCoy, Donald Dexter Van Slyke, Robert R. Williams, Edward A. Doisy, Thomas Midgley, Jr., and Conrad Arnold Elvehjem.

SCIENTIFIC NOTES AND NEWS

DR. YANDELL HENDERSON, professor emeritus of applied physiology at Yale University, died on February 18 in his seventy-first year.

DR. CHARLES B. DAVENPORT, until his retirement in 1934 for thirty years director of the Station for Experimental Evolution of the Carnegie Institution at Cold Spring Harbor, N. Y., died on February 18 in his seventy-eighth year.

THE William Freeman Snow Medal was presented at the annual dinner meeting of the American Social Hygiene Association to Dr. Hugh S. Cumming, director of the Pan American Sanitary Bureau, previously

surgeon general of the U. S. Public Health Service, in recognition of "outstanding service in the field of social hygiene."

Selwyn G. Blaylock, president and managing director of the Consolidated Mining and Smelting Company of Canada, Ltd., received a certificate of honorary membership at the annual meeting of the American Institute of Mining and Metallurgical Engineers, which was held in New York City on February 23.

The officers of the American Society of Zoologists elected for the year 1944 are: *President,* Dr. Sewall Wright, the University of Chicago; *Vice-president,* Dr. H. W. Stunkard, New York University; *Secretary,* Dr. L. V. Domm, the University of Chicago; *Treasurer,* Dr. H. W. Beams, the State University of Iowa; *Member of the Executive Committee,* Dr. T. S. Painter, University of Texas.

Dr. George Grey Turner, professor of surgery in the University of London, has been elected to deliver the Hunterian oration for 1945 of the Royal College of Surgeons of England.

Dr. A. H. Gale delivered the Milroy lectures of the Royal College of Physicians of London on February 22 and February 24. His subject was "A Century of Changes in the Mortality and Incidence of the Principal Infections Which Cause Death or Disability in Childhood."

Colonel Blake Ragsdale Van Leer, dean of the Consolidated Colleges of Engineering of the University of North Carolina and North Carolina State College, has been elected president of the Georgia Institute of Technology to succeed Dr. Marion L. Brittain.

Dr. Carl C. Lindegren, research associate at Washington University, St. Louis, has been appointed research professor on the staff of the Henry Shaw School of Botany. He will be assisted by Mrs. Gertrude Lindegren, Mrs. W. E. Pabor and others in directing research on the genetics of certain fungi, which is supported by an annual grant from Anheuser-Busch, Inc. He will also conduct a research course at the university on the genetics of fungi.

Dr. Stuart A. Wallace, chairman of the department of pathology of the School of Medicine of Baylor University, has been appointed to the newly endowed Fulbright professorship of pathology. The endowment is a memorial to the late R. C. Fulbright founded by his widow, Mrs. Irene Fulbright.

Associate Professor Chester Russell, Jr., acting head of the electrical engineering department of the Michigan College of Mining and Technology, has resigned to accept an industrial position. Resolutions of regret were passed by the executive committee of the faculty and by the college branch of the Society for the Promotion of Engineering Education, whose secretary-treasurer he was. Professor George W. Swenson, head of the department, will return to the college after an eighteen-months leave of absence for service with the armed forces as special consultant.

Appointments at the School of Medicine of Baylor University include Dr. Kenneth L. Burdon, of the School of Medicine of the Louisiana State University, professor of bacteriology; Dr. John H. Perry, of the Medical College of the State of South Carolina, assistant professor of anatomy; Dr. Paul A. Wheeler, assistant professor of pathology at Washington University, St. Louis, associate professor of pathology, and Dr. S. Earl Kerr, of the U. S. Army Medical Corps, instructor in pathology.

Dr. W. H. Newton, since the outbreak of the war acting head of the department of physiology at University College, London, has been appointed George Holt professor of physiology in the University of Liverpool, in succession to Dr. Herbert Eldon Roaf, who is retiring at the end of March.

Dr. Martin D. Young, senior parasitologist of the National Institute of Health, has been commissioned as sanitarian (R) in the U. S. Public Health Service. Dr. Young is in charge of the Malaria Research Laboratory of the National Institute of Health at Columbia, S. C., and also of the newly organized "Imported Malaria Studies" program.

Dr. Wilton L. Halverson, Los Angeles, director of the California State Department of Public Health, has been appointed a member of the board of scientific directors of the International Health Division of the Rockefeller Foundation.

Dr. Harold E. Jones, professor of psychology and director of the Institute of Child Welfare of the University of California at Berkeley, has been elected a member of the board of directors of the National Social Science Research Council.

Dr. Willis L. Tressler, of the department of zoology of the University of Maryland and the Chesapeake Biological Laboratory, has leave of absence for the duration of the war to assist in the specialized equipment research program of the Federal Government.

Dr. Harold W. Werner, pharmacologist of the National Institute of Health of the U. S. Public Health Service, has been appointed head of the department of pharmacology of the research laboratories of the Wm. S. Merrell Company in Cincinnati.

Dr. Elmer Walker Brandes, pathologist-in-chief in charge of the divisions of sugar-plant and rubber-

plant investigations of the Department of Agriculture, returned to the United States on February 14 after a visit to Africa. It is reported in the daily press that he brought back with him seeds of a sugar-bearing plant which he believes could be grown in the Gulf states.

AFTER his return to England from the Middle East to present to the British War Office and the Medical Research Council a report on the use of penicillin for war wounds, Professor H. W. Florey, of the University of Oxford, visited Russia to acquaint physicians there with his work on its development.

DR. FRANK A. BEACH, chairman and curator of the department of animal behavior at the American Museum of Natural History, addressed members of the faculty and graduate students of the departments of zoology and psychology at Indiana University on February 7. His lecture was entitled "The Neural and Hormonal Factors Involved in Reproductive Behavior."

DR. A. D. MACDONALD, dean of the Medical School of the University of Manchester, England, discussed plans for medical education in Great Britain after the war at the final session of a six-weeks symposium at the College of Medicine of New York University on "Medical Education in Relation to the Practice of Medicine of the Future."

A TWO-DAY symposium, on the industrial application of x-ray diffraction, sponsored jointly by the New York Section of the American Physical Society and the department of chemistry of the Polytechnic Institute of Brooklyn, was held at the institute on February 25 and 26. Representatives of more than sixty industrial firms were in attendance.

THE second war conference of the American Ceramic Society, Inc., will be held from April 2 to 5 at the Hotel William Penn, Pittsburgh. On Sunday night, April 2, the Edward Orton, Jr., Memorial Lecture will be given by Professor Hoyt C. Hottel, of the Massachusetts Institute of Technology. He will speak on "Radiant Heating."

THE International Association for Dental Research will hold its general meeting at the Drake Hotel, Chicago, on March 18 and 19 and the American Association of Dental Schools meets there from March 20 to 23.

IT is stated in *Nature* that a lecture on a chemical engineering subject has been endowed by J. Arthur Reavell, and will be given under the auspices of the British Institution of Chemical Engineers. It will be known as "The J. Arthur Reavell Lecture" and will be delivered not less frequently than once in every four years.

THE British Colonial Office announces that plans have been made to spend another £500,000 this year on the health program of Trinidad, £100,000 more than in 1943. New specialists in the hospitals, higher salaries for nurses and the appointment of a new officer of health education to supervise the teaching of hygiene in schools are among the improvements planned.

IT is reported that a British Scientific Film Association was formally constituted at a meeting held on November 20. Its primary aim is to promote the national and international use of scientific films in order to achieve the widest possible understanding and appreciation of scientific method and outlook, especially in relation to social progress. It will also collect, collate and distribute information on the scientific film, and publish comprehensive lists of films graded according to scientific merit and suitability for audiences. The association hopes to establish relations with government departments, public bodies and other organizations.

ACCORDING to the *Journal* of the American Medical Association the development of a rickettsia and virus laboratory in China by the Chinese National Health Administration is going forward with the cooperation of the American Bureau for Medical Aid to China and United China Relief. Dr. Chen-Hsiang Huang, instructor in medicine and virus research at the College of Physicians and Surgeons of Columbia University, fellow of the Rockefeller Institute for Medical Research, is *en route* to China to direct the work as head of the department of experimental medicine in the National Institute of Health. According to a release from United China Relief, at the present time there is no medical school or institution in China equipped to carry on virus research, and the rickettsia and virus laboratory will be the first of its kind in that country.

BOOKS RECEIVED

BROUWER, DIRK, FREDERIC KEATOR and D. A. MCMILLEN. *Spherographical Navigation.* Illustrated. Pp. xxiii + 200. Macmillan Company. $5.00.

DAUS, PAUL H., JOHN GLEASON and WILLIAM M. WHYBURN. *Basic Mathematics for War and Industry.* Illustrated. Pp. xi + 277. Macmillan Company. $2.00.

FREY, AUSTIN R. *Fundamentals of Radio Communications.* Illustrated. Pp. xii + 393. Longmans, Green and Co. $4.00.

MACCAULEY, C. B. F. *The Helicopters Are Coming.* Illustrated. xi + 165. Whittlesey House—McGraw-Hill Book Co. $2.00.

Practical Radio and Electronics Course. Three Volumes. "Fundamentals of Radio and Electronics," "Receivers, Transmitters and Test Equipment" and "Applied Electronics and Radio Servicing." Pp. 267. Illustrated. Prepared under the direction of M. N. BEITMAN. Supreme Publications. $3.95, set.

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AGRICULTURAL RESEARCH IN THE WAR AND AFTER[1]

By Dr. E. C. AUCHTER

ADMINISTRATOR OF AGRICULTURAL RESEARCH, U. S. DEPARTMENT OF AGRICULTURE

RESEARCH workers in our State agricultural experiment stations, in the Federal Department of Agriculture, in universities and other research and educational institutions and in industry have faced a tremendous challenge during this war. That they are meeting it successfully is witnessed by the result—an unprecedented agricultural production, the development and utilization of new foods, drugs, fibers and strategic materials of many kinds; improved methods of distribution, packaging and processing of agricultural products; and increased knowledge of requirements for foods and other products needed in everyday living. These results have been made possible by utilizing the materials and knowledge accumulated through scientific research, as well as by effective organization for developing new knowledge to meet emergency needs. Scientists in all fields related to agriculture are playing an important part in this work and will play an even more impotant one in the future. Just as great a challenge awaits research in the post-war world as it faces now. By continuing to work together we shall be able to meet it.

But an overwhelming number of demands tumble upon each of us these days. In the complexity of details it is both difficult and important to keep the major problems clear and if possible see the general direction in which we are moving. So the question I wish to propound this morning is: What is the real value of the agricultural and related research work being carried on year after year in the form of thousands of big and little projects? We know that it is helpful to solve a lot of individual problems—but what do such solutions contribute as a whole for this nation and for mankind?

This question can be divided into three parts: What has agricultural research done in the past? What is it doing now? What can it do in the future?

[1] Address given at the fifty-seventh annual convention of the Association of Land-Grant Colleges and Universities, Chicago, Ill., October 27, 1943.

I realize that it would take many books and the knowledge and wisdom of many minds to answer these questions fully. I shall suggest only a few of the answers.

RESEARCH SHAPED OUR CIVILIZATION

If this meeting were being held in 1787, the year the Constitution was written, we would probably be a gathering of farmers. Nineteen people out of every twenty in those days lived on farms. Nineteen farm families could produce only enough surplus, beyond their own needs, to feed and clothe that one non-farm family. But we are meeting in 1943—and I assume that there is not one of us in this room who devotes himself exclusively to farming. Many of us came from farms originally (and some of us would like to be back there again). But we're not on farms—in fact, there are now only about four farm families in this country to each 20 non-farm families. China still has 19 farm workers to one non-farm worker—exactly where we were in 1787.

The conditions that have made it possible for so large a proportion of our families to be released from the necessity of being on farms have also made it possible for us to have in the United States so many roaring steel factories—networks of railroads—airplanes—automobiles—telephones—refrigerators—business and professional services of all kinds—and to turn out such huge quantities of material for ourselves and our Allies in this war. A comparatively few farmers can produce enough to feed and clothe many other people who can work in offices and factories and laboratories because they are not required to produce food and fiber directly for themselves.

These facts are generally known but are so elementary that we overlook them. I review them here because they summarize, more strikingly than anything else I can think of, what agricultural research has done and made possible in the past. It has increased agricultural efficiency, step by step, year by year; and that in turn has played a large part in enabling us to build and operate great industries.

It would be absurd and untrue, of course, to say that only research directly connected with agriculture has made our industrial development possible. Progress is based on the exchange of knowledge developed in many fields. But the fact remains that the research of the land-grant colleges, the State experiment stations, the U. S. Department of Agriculture and our universities and other institutions dealing more or less directly with agricultural and related problems has not only paralleled but to a large extent stimulated the great progress in agricultural efficiency made in this country since 1860—progress that helped make our industrial civilization possible. And our agricultural institutions have not been content with doing a vast amount of productive research; they have carried the results directly to the farmer and have shown him how to apply them, thereby cutting down the time that would otherwise be required for the adoption of new practises.

We are not going to stand still where we are. I believe that the possibilities for advance in the coming decades are at least as great as the achievements of the decades that are past. But we will not have these advances unless we maintain and in fact increase our agricultural research. In a civilization making such full use of applied science you have to run fast to stay where you are. If you want to move ahead, you have to run still faster.

THE UNDERPINNING OF WARTIME PRODUCTION

It is unnecessary to recall to this audience that after World War I there was a period of pessimism about research, especially during the depression, when there were huge surpluses of some farm products. There was a feeling that somehow research was at least partly to blame for those surpluses. It had shown us how to grow two blades of grass where one grew before, and now we apparently didn't need the second blade; no one wanted it, and it was a burden and a curse. With farmers experiencing such hard times, and many of them being driven out of business, some scientists wondered whether they were performing any really constructive function, and at times they were even made to feel rather uncomfortable.

The one good thing about the depression was that it finally drove home to many people that fact that those surpluses were not surpluses at all in relation to our needs, and certainly not in relation to world needs, since at least half of the world's people are not properly fed. The true situation was that scientific progress was far ahead, temporarily at least, of economic and social progress. We knew how to produce, but not how to get the products to the people who needed them. We did not know how to maintain what the economists call "effective demand."

Then came the present war. Incidentally, many think that modern war also is fundamentally due to the fact that economic and social progress have been unable to keep pace with scientific progress. But the war has completely reversed any feeling that we knew too much about how to produce. It automatically did what we were not wise enough to do in peace. The war created "effective demand," in terms of astronomical figures. And mark this point well—we could not have met that demand if it had not been for the advances our farmers have made in production on a scientific basis during the past few decades, coupled with the ability of those organized to serve the nation

—agronomists, horticulturists, soils experts, economists, entomologists, botanists, pathologists, agricultural engineers, biochemists, home economists, dairy and animal husbandmen, extension specialists, administrators, and others in many specialized branches of science—to mobilize and extend our resources quickly to meet new emergency problems. In very large measure, we were ready, and all these fields have been called upon and many individuals utilized in far greater measure than can be disclosed until peace has been restored.

Mobilization of Research for War

I have said before that in a sense agriculture itself is a kind of warfare—against adverse weather conditions, lack of soil fertility, diseases, insects and all the other enemies of maximum production and utilization of farm products of many kinds. Agricultural research has long been mobilized, and must remain mobilized, in a campaign that will never end against these enemies.

But we have had to have a more intensive mobilization to meet the tremendous needs of to-day. More than two years ago, experiment station directors and staffs, seeing the problems ahead, started to scrutinize their station research projects carefully. In an effort to have funds, personnel and facilities available to tackle many new problems, certain of the regular projects which apparently would not make as immediate or direct contribution as some others to the war were laid by, so to speak, until after the war, or until circumstances indicated the need to resume or intensify work on them. The resources of the State agricultural experiment stations have been marshalled for the job of supplying facts to solve many of the problems involved in the record demands for food, feed and fiber occasioned by the war. Care has been taken, however, to prevent the loss of long-time experiments, such as soil fertility plots, and of valuable plant and animal material.

In the fiscal year 1942, Dr. Jardine, chief of the Office of Experiment Stations, tells me that there was an increase of 16 per cent. in the number of research projects undertaken by the States under Federal-grant funds compared with the average of the five preceding years, and that the regular research projects were modified where necessary to have them contribute more directly to the war effort. In 1943, there were over a thousand research undertakings by the States involving cooperation with bureaus of the Agricultural Research Administration and agencies of the War Food Administration. Many of these projects, of course, had been in progress before the war.

In the Federal Department of Agriculture in December, 1941, the Secretary of Agriculture grouped several agencies into an Agricultural Research Administration with the purpose of coordinating and centering research activities of the department upon war needs. To review briefly: The field covered by the Research Administration includes the following research bureaus—Animal Industry, Dairy Industry, Human Nutrition and Home Economics, Entomology and Plant Quarantine, Agricultural and Industrial Chemistry, and Plant Industry, Soils and Agricultural Engineering—the Beltsville Research Center, the Office of Experiment Stations and the four Regional Laboratories devoted to research on the industrial utilization of farm products and by-products, and nine Bankhead-Jones laboratories devoted to research on certain agricultural problems common to groups of States in the major agricultural regions.

By coordinating the work of those research agencies even more closely than in the past, it is possible to plan and carry out concerted attacks on certain problems and get important results more quickly than would have been possible without such close teamwork. Early in the war, we in the department also critically examined our whole list of projects, laid aside work that could be postponed if it did not bear immediately on war needs, reoriented other projects to meet wartime demands, and prepared to take on the many emergency projects that have been continually developing since the war began. In making these changes we, too, have been careful, of course, not to waste any stocks of valuable material or jeopardize long-time research programs. Ninety-two per cent. of current research activities in the Agricultural Research Administration are directly connected with the war.

The ability of this nation progressively to increase its production of food, feed and fiber during the past three years is due to a great extent to the large accumulation of data from past research and the all-out application of research agencies to the job of interpreting and applying accumulated facts and acquiring new facts which could be disseminated by extension agencies to the farmers, who were confronted with what looked to some an almost impossible task.

It was relatively easy for all of us to determine what increases of certain products were needed, but among other things, such as supplies of labor, farm machinery, fertilizer, etc., the accomplishment of the goals has involved greater efficiency in using soil resources; superior seed stocks of improved crop varieties; improved growing, harvesting, distribution and utilization practises; improved animal feeds and feeding, and reduction in losses from insect pests and diseases. In meeting the demands for more livestock, it was necessary to produce more feed, to make maximum use of pasture and roughages and to provide substitutes for some feedstuffs.

Vice-President Wallace emphasized the importance

of agricultural research in a statement he made recently: "It is only because of the extraordinary technological discoveries of the U. S. Department of Agriculture and the State experiment stations in soil management, crop breeding, and livestock feeding that we . . . have been able so far this year to ship food abroad at an annual rate of about 10 billion pounds." In other words, back of the ability to ship this great quantity of food, and at the same time feed our own people adequately, is the ability to produce food; and back of the ability to produce it are the intelligence and will of our farmers and the years of patient fact-finding of our scientists.

The emphasis and the concentration of investigators on special problems as well as the whole-hearted cooperation between State and Federal workers and those in other research and educational institutions have resulted in many contributions of decided value in the war. As perhaps never before, projects have been coordinated and the services of individuals with special technical knowledge have been used.

As examples illustrating how scientists have cooperated in attacking regional and national problems connected with the war, I might mention the nation-wide cooperative study of how best to conserve nutritive values of 69 different foods which is participated in by 46 experiment stations and the Department of Agriculture; and the cooperation of many State stations and the Department of Agriculture in determining where kok-saghyz (the Russian rubber-bearing dandelion) and various fiber and drug plants can be grown.

Many important agricultural problems during the past few years have been investigated by the nine Bankhead-Jones regional research laboratories. These laboratories were organized in cooperation with the State agricultural experiment stations and were located in different sections of the country. Valuable knowledge has already been obtained in the fields of vegetable breeding, salinity in irrigated soils, animal and poultry diseases, pasture improvement, soybean production, sheep and hog breeding and the interrelation of soils, plants and animal nutrition.

Similarly, the four regional laboratories at Albany, Calif., New Orleans, La., Philadelphia, Pa., and Peoria, Ill., organized to find new and industrial uses of farm products and by-products, have already made discoveries important to the war as well as to our domestic economy.

Thus, although faced with difficulties in retaining an adequate number of trained research workers and in maintaining essential facilities during the past two years, the experiment stations, the U. S. Department of Agriculture, universities and other research institutions have solved many new problems and have increased the volume of their services. A few examples will illustrate recent accomplishments:

(1) At the beginning of the war, we were dependent on foreign countries for supplies of certain drug, fiber and rubber goods obtained from plants. Now through the cooperation of the scientists at the State experiment stations, universities, research institutions, drug manufacturers, industrial research laboratories, farmers and the Federal Government, we have found ways of growing, harvesting and processing these crops. In some cases, our needs are wholly being met; in others, we are in position to meet most of the essential needs if it becomes necessary.

(2) Faced with a shortage of labor, the agricultural engineers cooperating with other scientists have originated new labor-saving machinery for the planting, production and harvesting of several crops and have modified other machinery and developed new practises for such purposes as refrigerated transportation.

(3) Faced with the necessity of conserving shipping space, scientists in many fields have cooperated in determining how to dehydrate, ship, store and reconstitute many food products such as meat, milk, vegetables, fruit and eggs without undue loss of palatability and nutritive quality.

(4) At the request of the armed forces, entomologists have developed new and original methods of freeing and protecting men from body lice, mosquitoes and other insects. In cooperation with other scientists, they have developed substitutes for some of the insecticides and fungicides formerly used in agricultural production and now scarce.

(5) Chemists, physiologists and other scientists have solved a host of specific problems such as developing more efficient methods of obtaining alcohol from wheat; preventing the deterioration of fabrics for domestic use and military purposes; finding ways to make soft, downy fluff out of chicken feathers to substitute for down from waterfowl for filling sleeping bags and pillows for the armed forces; making new plastics derived from wood and from crop residues; increasing the flow from pine trees of oleoresin, much needed by the armed forces; successfully transplanting trees and shrubs at different times of the year for camouflage purposes; and modifying sterility and increasing the milk flow of animals by the use of hormones.

(6) Home economists, among many other activities, have investigated and given advice on how to cook food on a large scale, under conditions such as those found in service camps, so as to achieve great savings of nutrients; have calculated the nutritive values of available and potential food supplies as a guide for production and rationing policies; have found ways to use alternate foods and fibers and distributed an immense amount of information on how to get the maximum use out of products no longer made in liberal quantities; and have designed clothes and uniforms for special purposes and conditions.

(7) Much work, in the aggregate, has been done on the problems of nutrition, particularly in relation to protein supplies for both human beings and livestock. With shortages of protein feeds, especially of animal origin, a

limiting factor in livestock production, physiologists have had to determine how little could be used and to what extent one source of protein could be substituted for another in rations. Chemists and others have worked on the problem of recovering as much valuable protein as possible from distillery by-products instead of having it go to waste; and, incidentally, a new method has been developed for making alcohol from wheat which may have possibilities for large-scale protein recovery. In the case of diets for human beings, one of the main problems has been to work out ways of using more protein directly from plant sources rather than have it converted first to meat in the animal organism. Work done with soybean, peanut and cottonseed products has shown the nutritional value of their proteins, and home economists have developed many recipes and formulas for the use of soybean products. In this connection, recent research on amino acids promises to give us a more accurate knowledge of protein nutrition than we have yet had.

During the war, too, plant breeders have carefully studied new materials of promise which were near the end of pre-distribution tests. Where certain ones possessed attributes which indicated they would reduce production risks, they have been increased for immediate farm use and distributed. The introductions have included cereals, fruits, vegetables, cotton, soybeans, sugarcane and other important crops.

I should like to discuss certain other contributions of value to the armed forces, but of course that can not be done now. Some day when all the contributions of science to the war can be told, they will make an extraordinary story.

The Value of Fundamental Research

The few examples just given illustrate the originality, ability and cooperativeness of agricultural scientists. They show that agricultural research, both abstract and applied, carried on during peace times has been immensely useful in time of war. Naturally applied science must be stressed in all agricultural research carried on by public agencies. But the development of basic information and the discovery of principles upon which practise can be based make it possible to arrive at a more speedy, direct and satisfactory solution of problems. The whole progress of science and the application of its findings depends on filling in the gaps in our knowledge of the nature of things. There is a very definite limitation indeed to the extent of progress which can be made without a backlog of fundamental knowledge.

Hybrid corn, planted on approximately 50,000,000 acres this year, is a familiar example. We all know that the development of hybrid corn was preceded by a good deal of work which most people would consider purely theoretical genetics. Perhaps not all of it was essential to the practical breeding operations, but a good deal of it was. Waxy corn was a by-product of some of this work; it had no practical value at the time it was discovered but was carried along for its theoretical interest. Now it is of very great importance, along with waxy sorghum, as a source of a possible substitute for tapioca starch.

The work on the influence of day length on plant development and distribution is another case in point. Among many other things, an understanding of the photoperiodic requirements of different plants has affected agricultural production in widely different ways. It has made it possible, for example, to produce potato seed for breeding purposes under controlled conditions in large quantities, to determine the adaptability of many kinds of plants to widely separate areas and eliminate the practise of trying to grow them in regions to which they were not suited, and to control the blooming time of chrysanthemums and other florists' crops; and it has helped to make it possible for us to become independent of foreign sources of sugar-beet seed.

Another example is the seemingly abstract research on the effects of plant hormones on the physiological and anatomical responses of plants. This work has been applied to the prevention of early dropping of fruits, facilitating the rooting of plants for propagation and transplanting, wound healing, maintaining the dormancy of nursery stock, fruits and vegetables in storage, greatly increasing the percentage of fruit set on crops such as tomatoes, and increasing the size of some fruits. There have been many other applications, and a whole new chapter in man's control of plant development through chemical means is in the making.

An especially striking example of the importance of supporting fundamental research is found in the remarkable results now being obtained with penicillin in preventing or clearing up infections. All the funds that have been provided for many years to study the growth, reproduction, physiology, relationships and life histories of the many species of plants grouped under the general term "fungus" would be justified by this one discovery, even if all such work had not already been paid for very many times over by economic applications of the results of critical research. Because of the knowledge of investigators versed in the cultivation of fungi on a large scale, it will now be possible to produce large quantities of penicillin and save the lives of thousands of people.

These examples are singled out from among hundreds of outstanding contributions which have had their basis in fundamental research because they are of great current interest and because they bring home to us the direct connection between the accumulation of basic knowledge and its application in a highly practical and often dramatic way.

(To be concluded)

OBITUARY

CASWELL GRAVE

January 24, 1870—January 8, 1944

CASWELL GRAVE was born and raised on a farm near Monrovia, Indiana. His parents were industrious and prosperous members in good standing of the Society of Friends, to which nearly every one in the community belonged. He was therefore from childhood surrounded by wholesome religious and social influences. He carried his full share of the responsibilities and often arduous duties of life on a farm until he graduated from Earlham College and entered the Johns Hopkins University in 1895, where he soon came under the influence of the eminent philosophical zoologist, W. K. Brooks. He remained in this institution as student, teacher and investigator until 1919, when he was called to Washington University, St. Louis, as professor of zoology and head of the department. He held this position until he retired in 1939 and moved to his new home in Winter Park, Fla.

Soon after graduating from the Johns Hopkins University with the Ph.D. degree he began investigations during the long summer vacations in the laboratory of the U. S. Commisison of Fish and Fisheries, first at Woods Hole, Mass., and later at Beaufort, N. C., where he was director of the laboratory for four seasons (1902–6). Here he became interested in the biology and the culture of the oyster, and later, after having devoted nearly his entire time to this subject for six years (1906–12) as shellfish commissioner of Maryland, he was widely recognized as the foremost expert on the subject in this country.

His investigations were extraordinarily ingenious, thorough and comprehensive and his writings rich in thoroughly substantiated, wise counsel concerning especially the oyster industry; counsel which although unfortunately frequently disregarded, has nevertheless been of great practical value.

Dr. Grave was for many years closely associated with the Marine Biological Laboratory at Woods Hole, Mass., as student, instructor, investigator and trustee (1901-44). Here and in the Carnegie Laboratory at the Dry Tortugas, Fla., he devoted much time to a comprehensive series of wisely planned and meticulously executed studies concerning the structure, development and interrelationship of ascidians. These studies were still in progress at the time of his death. The results obtained are profound in significance, especially those concerning the factors involved in the metamorphosis of the tadpoles.

In his extensive experience as a teacher and an executive Dr. Grave was eminently successful. He was always clear, precise, sympathetic, sincere and above all absolutely honest. The climax of his life's work in these fields was reached in Washington University, where in some ten years he built up a department from almost nothing to one of the foremost in the country, in research as well as in teaching.

For more than thirty years Caswell Grave was one of my most intimate associates. He was ever most generous in collaboration and very helpful and encouraging in criticism; wise in counsel and congenial in social intercourse, a true and trusted friend.

S. O. MAST

JOHNS HOPKINS UNIVERSITY

RECENT DEATHS

DR. LEO HENDRIK BAEKELAND, honorary professor of chemical engineering of Columbia University, inventor of bakelite, died on February 23. He was eighty years old.

DR. EDWARD OSCAR ULRICH, geologist and paleontologist, died on February 22 at the age of eighty-seven years. Dr. Ulrich was a member of the U. S. Geological Survey from 1897 until his retirement in 1932. Since then he has continued his work at the U. S. National Museum, of which he had been an associate since 1914.

DR. DOUGLAS WILSON JOHNSON, Newberry professor of geology and chairman of the department of geology of Columbia University, died on February 24. He was sixty-five years old.

DR. FREDERICK GARDNER CLAPP, consulting geologist and petroleum engineer of New York City, died on February 18. He was sixty-four years old.

ELTON DAVID WALKER, professor emeritus of civil engineering at Pennsylvania State College, died on February 24 at the age of seventy-four years. He had been affiliated with the college since 1900, serving as head of the department of civil engineering from 1907 until his retirement in 1939.

DR. ROY E. DICKERSON, petroleum specialist for the technical branch of the Foreign Economic Administration, died on February 24 in his sixty-seventh year.

MILLER REESE HUTCHISON, of the Hutchison Laboratory, New York City, engineer and inventor, died on February 16 at the age of sixty-seven years.

DR. LEE WALLACE DEAN, professor emeritus of otolaryngology of the School of Medicine of Washington University, St. Louis, died on February 8. He was seventy-one years old.

DR. CHARLES W. BURR, professor emeritus of mental diseases at the School of Medicine of the Univer-

sity of Pennsylvania, died on February 19. He was eighty-two years old.

DR. ELEANOR ROWLAND WEMBRIDGE, psychologist, investigator of the Supreme Court, Los Angeles County, California, died on February 20 at the age of fifty years.

DR. ALEXANDER PRIMROSE, from 1918 to 1931 professor of surgery and from 1920 to 1932 dean of the faculty of medicine of the University of Toronto, died on February 8. He was eighty-two years old.

SIR JOHN FARMER, F.R.S., professor emeritus of botany, formerly director of the biological laboratories of the Imperial College of Science and Technology, South Kensington, died on January 26 in his seventy-ninth year.

DR. WILLIAM WHITEMAN CARLTON TOPLEY, from 1927 to 1941 professor of bacteriology and immunology at the University of London, and director of the School of Hygiene and Tropical Medicine, died on January 21 at the age of fifty-eight years. He was a member of the Scientific Advisory Committee of the War Cabinet and of the Colonial Research Advisory Committee.

SCIENTIFIC EVENTS

THE IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY AND THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

The Times, London, for January 14 prints the following letter from R. V. Southwell, rector of the Imperial College of Science and Technology, South Kensington:

Shortly after the last world war various colleges of Oxford and Cambridge "paired" in a voluntary and informal arrangement whereby each college so allied extends to members of its "opposite number" hospitality during occasional visits and the normal privileges of its common room. To-day a somewhat similar engagement is announced. The Massachusetts Institute of Technology has accepted proposals made by the Imperial College of Science and Technology to its president, Dr. Karl T. Compton, during his short visit to this country last summer, and the two institutions are planning to maintain, after the war, a regular interchange both of staff and of post-graduate students.

Somewhat exceptionally, of the two the American has the longer history. Its charter, stating among its purposes "the advancement, development, and practical application of science in connection with arts, agriculture, manufactures and commerce," was granted by the Commonwealth in 1861. Not until nearly fifty years later (in 1907) was Imperial College established with a charter stating closely similar aims: ". . . to provide . . . the most advanced training and research in various branches of science, especially in its application to industry." Thus "M.I.T.," as it is known throughout the world, has had a life of more than 80 years, and those years of peace; Imperial College has existed hardly half as long, and of its life nearly one quarter has been lived in time of war.

In view of this inequality, it need not be matter for surprise or jealousy that the American institution has the wider fame. It had, moreover, the advantage of being planned for its technological purpose from the beginning (by William Barton Rogers, of Virginia, its first president); Imperial College (as is the English way) was formed by an incorporation of three existing colleges, founded independently and with different aims. Add to this that in general the British bent has been towards pure science, that of America towards the side of practical application, and the fame of "M.I.T." requires no further explanation. It is ground for the more satisfaction to Imperial College that she should thus be recognized as its "opposite number"; and the alliance is an earnest of her intention to develop to the utmost, after the war, advanced technological instruction and research.

THE PROPOSED SURVEY OF MARINE AND FRESH-WATER FISHERIES

SENATOR JOSIAH BAILEY, of North Carolina, chairman of the Senate Committee on Commerce, introduced in the Senate on January 26 a resolution directing the Fish and Wildlife Service to conduct a survey of the character, extent and condition of the marine and fresh-water fishery resources and other aquatic resources of the United States and its territories, including the high seas resources in which the United States may have interest or rights. The resolution sets forth in detail the type of information desired and requires a report on commercial and recreational fisheries to be submitted to Congress not later than January 1 next. If the resolution is adopted, it will be the first time since 1871 that Congress has of its own initiative directed a report of this nature.

Charles E. Jackson, assistant deputy coordinator of fisheries, in his remarks before the consultants of the Office of the Coordinator of Fisheries on February 3 spoke in part as follows:

To carry on proper exploration of the possibilities of our fisheries, a research vessel or vessels are essential. The United States is the only important maritime nation that is without a fishery research vessel, although our coastline is far more extensive than that of nations that have long had adequate research equipment. The history of our recent efforts to obtain a vessel are worth recounting briefly. The old *Albatross II* which the former Bureau of Fisheries operated was practically worn out in 1934, and since the Government policy at that time was to reduce expenses we could not justify its operation ex-

pense. Later when we requested relief funds to build a research vessel we were informed that funds would be allocated only to replace old vessels and on projects where no new personnel were needed. Unfortunately, the Bureau of Fisheries in good faith had several years previously abandoned its vessel and discharged its crew. The New England industry proposed and Congress passed an act authorizing a research vessel for the North Atlantic. Although we repeatedly requested funds to carry out this mandate of Congress, no money was forthcoming. The General Seafoods Corporation sold us an old trawler—the *Harvard*—for $1.00. When the Bureau of Fisheries was transferred to the Department of the Interior, almost the first act of Secretary Ickes was to allocate Public Works Administration money to rebuild the *Harvard* and convert it into a research vessel. Just before the work was completed the Navy took it over and reconverted it for Navy use. If the vessel should be released to us to-day it would be unsuitable for our work.

When Japan filed notice she would abrogate the Fur Seal Treaty, we secured an appropriation and purchased the *Black Douglass*. Necessary repairs were made, a crew was hired and scientific personnel made available to trace the migration of fur seals. The vessel sailed from Savannah, Georgia, arrived in Seattle, where investigation headquarters had been established, but a few days later was taken by the Navy. That's the tragic story of our efforts to get research vessels for the past ten years.

We need not one, but several research and fishing experiment boats. Some should be of the practical fishing vessel type such as purse seiners. We need two or three large research vessels capable of following migrations of pelagic species wherever they may roam in the sea.

To develop the latent fisheries of the United States it will be necessary to have team work among the Government, the fishermen and the processor. As I see the problem, it is the Government's responsibility to undertake the exploration of our waters. We need vessels equipped with various types of gear to ascertain the abundance of supply by species; to determine the extent to which the fishery can be utilized without threatening depletion; to locate the most productive banks; and to determine what measures should be taken to insure an adequate spawning stock, perhaps by setting aside nursery or spawning areas. Experiments should be conducted to ascertain what type of gear can obtain best results.

THE ARGENTINE CITIZENS DECLARATION

THE following letter has been addressed to Secretary of State Hull by the American Association of Scientific Workers in appreciation of the declaration for effective democracy and American solidarity recently issued by distinguished citizens of the Argentine:

Many of our scientific colleagues and friends of Argentina, recognizing that democracy and human freedom are essential to the welfare of mankind and to the progress of science, recently joined with other leaders of Argentina in issuing a "declaration for effective democracy and American solidarity." A considerable number of scientists and educators, including men such as Professor Bernardo A. Houssay, Nobel laureate, Latin America's greatest scientist, were among the one hundred and fifty signers of the declaration.

We rejoice that our fellow scientists have taken the lead in rallying the Argentine people behind "those of the world fighting for democracy." The American Association of Scientific Workers honors the high purpose and courage of our Argentine colleagues. On our part, we pledge that we shall do our full share in the war against fascism and that we shall strive for a victorious peace and for a democratic world in which all peoples will live in solidarity.

The American Association of Scientific Workers notes with great distress that the signers of the declaration have been censured and, by order of the President of Argentina, dismissed from their posts in the universities and services for subscribing to a document which, in essence, simply approves the principles of democracy and calls for the cooperation of free men in its preservation. Some of the signers, such as Professors Houssay, Castex and Romano, are reported to have taken refuge in Uruguay.

The American Association of Scientific Workers affirms that the existence of such an anti-democratic policy in one of the great countries of the Western hemisphere is a menace to the welfare of all the peoples in this hemisphere. Recent events confirm our view. Our association further asserts that the failure of the democratic nations of this hemisphere to condemn officially and to exert pressure to rectify this action of the Argentine Government would be a serious error, first because great injustice has been done, and second because the cause of democratic nations is weakened by ignoring the suppression of liberty and democracy.

Therefore, the American Association of Scientific Workers respectfully but urgently suggests that the Government of the United States of America, in concert with other nations of this hemisphere, take whatever actions may be most effective to the end that the Government of Argentina rescind its undemocratic decrees.

(Signed) KIRTLEY F. MATHER, *President*
HARRY GRUNDFEST, *National Secretary*
American Association of Scientific Workers

AWARDS OF THE AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS

AT the annual dinner and honors night of the American Institute of Mining and Metallurgical Engineers, which was held in New York City, on February 23, the Charles F. Rand Memorial Medal for distinguished achievement in mining administration was presented to Cornelius F. Kelley, chairman of the board of the Anaconda Copper Mining Company, and an associate of more than thirty companies.

The citation reads: "For conspicuous success as administrative head of great enterprises engaged in the production of non-ferrous metals at home and abroad; for inspiring leadership of an organization that has

trained able engineers for service wherever ores are mined and metals are recovered; for enhancing the prestige of metal mining in the financial and industrial world."

The William Lawrence Gold Medal "for distinguished achievement in mining" was presented to George B. Harrington, president of the Chicago, Wilmington and Franklin Coal Company of Chicago.

The Anthony L. Lucas Medal "for distinguished achievement in improving the technique and practice of finding and producing petroleum," was presented to Charles Ormer Millikan, chief engineer of the Amerada Petroleum Corporation, Tulsa, Okla., "for his outstanding contributions to engineering in the development and production of petroleum."

Selwyn Gwillym Blaylock, president and managing director of the Tadanac plant of the Consolidated Mining and Smelting Company of Canada, Ltd., at Trail, B. C., received a certificate of honorary membership in the institute "in recognition of his eminent standing as a metallurgist, engineer and administrator of mining and metallurgical enterprises and the effective and patriotic services he has rendered his country and the United Nations in these critical times."

The Robert W. Hunt Gold Medal and money prize given for "the best original paper on iron and steel contributed to the institute" was presented to Clarence D. King, metallurgist of the United States Steel Corporation of Pittsburgh.

The J. E. Johnson, Jr., award of a cash prize and certificate, given to metallurgists not over forty years of age for contributions to the metallurgy or manufacture of pig iron, was presented to Leonard A. Tofft, general foreman of the new blast furnaces of the Inland Steel Company at Indiana Harbor, Ind.

THE RICHARD PEARSON STRONG MEDAL

The American Foundation for Tropical Medicine, Inc., announces the establishment of an award for outstanding achievement in the field of tropical medicine to be awarded periodically as circumstances determine. This award is to be known as the Richard Pearson Strong Medal for distinguished achievement in tropical medicine. It consists of a paladium medal together with a cash honorarium of $500, the gift to the foundation of the Winthrop Chemical Company. The first award was presented to Colonel Strong at the annual meeting of the American Foundation for Tropical Medicine at the University Club, New York, on February 28. Admiral E. R. Stitt, M. C. (retired), former Surgeon General of the United States Navy, made the presentation. The citation reads:

The medal and award for distinguished achievement in tropical medicine has been established to honor outstanding contributors to this important field of the medical sciences. It is fitting that it should bear the profile and the name of a distinguished American physician who has devoted his career to this branch of medicine and whose name is known throughout the world. It is peculiarly appropriate that the first award should be made to him.

A scientist, who since his appointment in 1899 as president of the first Board for the Investigation of Tropical Diseases in the Philippine Islands, and subsequently as director of the Philippine Government Biological Laboratory in Manila, has made fundamental contributions to scientific knowledge of many tropical diseases, including bacillary and amebic dysentery, cholera, bubonic and pneumonic plague, beri beri, yaws, tropical ulcer and tropical skin diseases, trypanosomiasis, typhus fever, filariasis, onchocerciasis—the blinding filarial disease of Africa and Central America—and Oroya fever.

Author of many important scientific articles and monographs dealing with tropical diseases and of the revised edition of the most distinguished American text on tropical medicine.

Leader of scientific expeditions to remote areas of the tropics of Africa and of the Amazon Valley, to Central America and the valleys of the Andes.

Samaritan, physician and leader of relief expeditions to the peoples of Manchuria stricken by a devastating epidemic of pneumonic plague, and later to Serbia which was in the throes of the great epidemic of typhus fever in 1915.

Teacher and professor of tropical medicine at the University of the Philippines from 1907 to 1913; professor of tropical medicine at Harvard University from 1913 to 1938; and organizer of the first graduate School of Tropical Medicine of the Western Hemisphere

Past president of the American Society of Tropical Medicine, the American Academy of Tropical Medicine, the American Society of Parasitologists and the Association of American Physicians.

Eminent figure in military medicine; member of the Inter-Allied Sanitary Commission in the first World War; consultant in tropical medicine to the Secretary of War; director of the Course in Tropical Medicine at the Army Medical School; and member of the Medical Corps of the United States Army in four wars; recipient of the Distinguished Service Medal in 1919 for exceptionally meritorious and distinguished services, notably as president of the board for the Investigation of Trench Fever—Colonel Richard Pearson Strong.

SCIENTIFIC NOTES AND NEWS

Four honorary members, one each from the four principal Allied Nations, have been elected by the British Institute of Metals. They are, for the United States, Dr. Irving Langmuir, associate director of the research laboratories of the General Electric Company; for Great Britain, Sir Lawrence Bragg, Cavendish professor of experimental physics at the University of Cambridge; for China, Madame Chiang

Kai-Shek, and for the U.S.S.R., Professor Peter Kapitza, director of the Institute for Physical Problems of the Academy of Sciences, Moscow.

THE Lamme Medal for 1943 of the American Institute of Electrical Engineers has been awarded to Arthur H. Kehoe, vice-president of the Consolidated Edison Company of New York, Inc., in recognition of "pioneer work in the development of alternating current works and associated apparatus for power distribution." It is expected that the medal and certificate will be presented to him at the summer technical meeting of the institute, which will be held at St. Louis from June 26 to 30.

DR. V. E. SHELFORD, professor of zoology at the University of Illinois, has been made corresponding member of La Sociedad Mexicana de Historia Natural.

THE Council of the British Institution of Electrical Engineers has elected Sir Ernest Thomas Fisk, since 1932 managing director and chairman of Amalgamated Wireless, Australia, an honorary member of the institution in appreciation of his services in Australasia in the field of radio-communications.

THE honorary doctorate of science was conferred on February 25 at the commencement of the Worcester Polytechnic Institute on Dr. Wallace W. Atwood, president of Clark University.

CLARKSON COLLEGE OF TECHNOLOGY, Potsdam, N. Y., conferred the degree of doctor of engineering on Thorndike Saville, dean of the College of Engineering of New York University, at the forty-fifth commencement exercises on February 13.

THE American Academy of Orthopedic Surgeons has awarded its gold medal to Colonel John L. Gallagher, M.C., A.U.S., in recognition of his work on the development of compression dressings for burns, wounds and frostbite.

DR. GEORGE BAEHR, professor of clinical medicine at Columbia University, who since 1941 has been medical director of the U. S. Public Health Service and chief medical officer of the U. S. Office of Civilian Defense, will retire from government service on March 1. He will be succeeded by Dr. W. Palmer Dearing, who has been assistant chief medical officer. In recognition of his services to the hospitals of the country in time of war, the American Hospital Association at its recent annual meeting voted a special citation to Dr. Baehr and elected him to honorary membership.

IGOR SIKORSKY, inventor of the helicopter adopted by the Army Air Forces, was presented on February 13 by Fawcett Publications, Inc., with the 1943 aviation Trophy and the sum of $1,000.

DR. NIELS BOHR, professor of theoretical physics at the University of Copenhagen, has been elected a member of the Athenæum Club, London, under a rule which permits the "annual election by the committee of a certain number of persons of distinguished eminence in science, literature or the arts or for their public services."

EARL RUSSELL (Bertrand Russell), who has lived in the United States for some years, has been elected a fellow of Trinity College, Cambridge. He expects to return to England during the summer to resume his work in philosophy and mathematics.

THE second meeting of the Oregon Academy of Science was held in Portland on January 15. An organization meeting without a program was held on October 27 last. Officers elected were: *President-elect*, Stanley Jewett, regional biologist, the U. S. Fish and Wildlife Service, Portland; *President*, the Reverend Jos. S. McGrath, professor of chemistry and dean of the College of Science of the University of Portland; *Treasurer*, R. R. Huestis, professor of zoology at the University of Oregon, re-elected. Dr. A. L. Strand, president of Oregon State College, previously head of the department of entomology, will remain on the council as past president for this year. The present secretary is F. A. Gilfillan, dean of the School of Science of the State College, who continues for the second year of his term of office.

THE following officers were elected on February 4 at the annual meeting of the Branner Geological Club of Southern California at the California Institute of Technology: E. Robert Atwill, of the Union Oil Company, *President;* Beno Gutenberg, of the California Institute of Technology, *Vice-president,* and Clifton Johnson, of the Richfield Oil Company, *Secretary-Treasurer.* The principal address was given by Hoyt S. Gale and Rodney Gale on the geology of the Kramer borax deposits in southern California; Earl C. Noble showed colored motion pictures of Costa Rica and Guatemala.

DR. WALTER RAUTENSTRAUCH, of Columbia University, has been appointed visiting professor of engineering during the spring term at the North Carolina State College, Raleigh.

DR. LOUIS J. CURTMAN, professor of chemistry at the College of the City of New York, who has been connected with the college since 1907, has retired from active service.

R. M. FOSTER, of the Bell Telephone Laboratories, has been appointed professor of mathematics and head of the department at the Polytechnic Institute of Brooklyn.

DR. CORNELIUS OSGOOD, associate professor and chairman of the department at Yale University, curator of the Peabody Museum, has been promoted to a professorship of anthropology.

WILL C. MCKERN, curator of anthropology at the Milwaukee Public Museum, has been appointed director of the museum, succeeding the late Dr. Ira Edwards.

CHRISTOPHER W. COATES, a member of the staff of the New York Aquarium, has been appointed curator of fishes at the New York Zoological Park. Myron Gordon, also of the aquarium, has been made assistant curator.

DR. W. S. FLORY, JR., from 1936 to 1944 main station horticulturist at the Texas Agricultural Experiment Station, has received appointment as horticulturist with the Virginia Agricultural Experiment Station at Blacksburg.

DR. R. E. MORTIMER WHEELER, director of the Society of Antiquaries and keeper of the London Museum, has been appointed director-general of archeology in India.

DR. HOBART A. REIMANN, professor of medicine at Jefferson Medical College, visited Puerto Rico in December as guest of the Puerto Rican Medical Association in San Juan, where he gave several lectures on acute infectious diseases.

DR. REGINALD FITZ, lecturer on the history of medicine at the Harvard Medical School, delivered on February 24 an address entitled "Medicine and the Changing World" at the New York Academy of Medicine. The meeting was presided over by Dr. John F. Fulton, Sterling professor of physiology at the School of Medicine of Yale University.

DR. C. H. BACHMAN, physicist of the electronics laboratory of the General Electric Company, gave a lecture on February 25 under the auspices of the chapter of Sigma Pi Sigma of New York University. He spoke on the new electron microscope developed by him and Dr. Simon Ramo.

DR. H. J. MULLER, professor of biology at Amherst College, delivered on February 9 a lecture before the division of biological sciences of the University of Rochester. His subject was "Our Mutations."

DR. JUSTIN L. POWERS, chairman of the Committee of National Formulary and director of the laboratory of the American Pharmaceutical Association, addressed the Science Club of the University of Georgia on February 24 on "Official Drug Standards."

DR. JOHN W. OLIPHANT, surgeon, Division of Infectious Diseases, National Institute of Health, will deliver the sixth Harvey Society Lecture of the current series at the New York Academy of Medicine on March 16. He will speak on "Jaundice Following Administration of Human Serum."

THE Federation of American Societies for Experimental Biology, by vote of the executive committee, will not hold an annual meeting in 1944. Through the medium of the *Federation Proceedings*, however, provision will be made for the publication of abstracts of papers which would have been presented if it were feasible to hold such a meeting. Similarly, provision will be made for the full publication of papers contributed to several symposia. This arrangement corresponds to that which was made in 1943 when the annual meeting was also cancelled. It is now announced that a meeting will be held in Cleveland on May 8, 9 and 10, 1945, unless some unforeseen difficulty arises. The federation is composed of the American Physiological Society, the American Society of Biological Chemists, the American Society for Pharmacology and Experimental Therapeutics, the American Society for Experimental Pathology, the American Institute of Nutrition and the American Association of Immunologists.

APPLICATIONS for grants from the Cyrus M. Warren Fund of the American Academy of Arts and Sciences should be received by the chairman of the committee, Professor Frederick G. Keyes, Massachusetts Institute of Technology, Cambridge 39, Mass., not later than April 15. Grants are made in aid of chemical research, generally for apparatus or supplies, or for the construction of special facilities needed for research in chemistry or in fields closely related to chemistry. Grants are not awarded for salaries, and on account of limited resources the amount to an individual is seldom in excess of $300. Application blanks may be obtained from the chairman upon request.

THE following chemicals are wanted by the National Registry of Rare Chemicals, Armour Research Foundation, 33rd, Dearborn and Federal Streets, Chicago, Ill.: 1,2,3,4-Tetrahydroxy benzene (Apionol), l-Amino-2,3-hydroxy propane, 3-Amino-2-naphthol, l-Amino-9-octadecene, Barium platinic chloride (1 lb.), Benzyloxy Carbonyl Chloride (carbobenzoxy chloride), p-Chlorophenyl acetic acid, Comenic acid, or any ester thereof, Chelidonic acid or any ester thereof (Monoester, preferably), 1,7-Dihydroxy-6-naphthoic-3-sulfonic acid, Dibenzyl disulfide, Di-n-hexylamine (10 lbs.), Hexaphenyl ethane, Indazole (50 g), o-Iodosobenzoic acid, 2 Mercapto-1,3,4 thiadiazole and Stachydrine.

A SYMPOSIUM, sponsored by the division of industrial and engineering chemistry, on the post-war outlook for the chemical industry, will be held in connection with the one hundred and seventh meeting of the American Chemical Society which meets in Cleveland from April 3 to 7 under the presidency of Dr. Thomas

Midgley, Jr. Subjects to be discussed include financial problems of the transition period, the outlook for foreign trade in chemicals, the need for more intensive research, the prospect for new engineering developments, the enhanced importance of technical progress to management and trends in professional education. Dr. Lawrence W. Bass, director of the New England Industrial Research Foundation, will be chairman of the symposium. Ralph E. Flanders, president of Jones and Lamson Machine Company, Springfield, Vt., chairman of the Research Committee of the Committee for Economic Development, will deliver an address on "Technology and Industrial Management." Other speakers will be D. M. Sheehan, comptroller of the Monsanto Chemical Company, St. Louis; Dr. W. L. Badger, of Ann Arbor, manager of the consulting engineering division of the Dow Chemical Company; John B. Glenn, president of the Pan American Trust Company, New York, vice-president of the New York Board of Trade; Raymond Stevens, vice-president of Arthur D. Little, Inc., Boston, and Dr. H. S. Rogers, president of the Polytechnic Institute of Brooklyn.

THE late Lady Thomazine Mary Lockyer, widow of the astronomer Sir Norman Lockyer, bequeathed her residence and other house property to the Norman Lockyer Observatory Corporation, and the residue of her estate in trust for the benefit of the corporation. She left £100 to the British Association for the Advancement of Science.

The Times, London, reports that a grant of £28,600 has been made under the Colonial Development and Welfare Act to enable a tuberculosis survey to be made in Fiji, to determine the extent of the problem and the best means of dealing with it. It is hoped to extend the survey to the British Solomon Islands Protectorate and the Gilbert and Ellice Islands Colony.

Nature reports that the shipbuilding industry in Great Britain, after consultation with the Department of Scientific and Industrial Research and the Admiralty, has decided to establish a British Shipbuilding Research Association, to develop all branches of research associated with shipbuilding, marine engineering and ship repairing.

DISCUSSION

FLOCCULAR MASSES AND APPARENT ALTERATIONS IN SUNSPOT PENUMBRAE

IT is well known that high level, cloud-like masses of ionized Ca and other atoms are related in some way to ordinary sun spots. They are observed to be unusually active in the immediate neighborhood of spots and to partake of the vortical movement of the solar atmosphere about such spots. Unlike the spots, however, individual flocculi can not be observed by direct vision. Observation of the various kinds of flocculi are by spectroheliograms, generally obtained in the K line of Ca for that element, in the Hα line for H, and so on.

Some time ago it occurred to the writer that under certain conditions floccular masses composed of various atoms and having a general absorption and emission might be seen by direct vision, or at least might be demonstrated by the masking effect such masses would have in passing over the dark parts of a sun spot.

That flocculi of various kinds, both Ca and H, for instance, overlie spot groups is, of course, common knowledge. However, the writer proposes that certain apparent changes in the penumbrae of sun spots may often be illusionary, due to the movements of superimposed floccular masses, having general emission and absorption, which are thus rendered directly visible. Both Ca and other atoms may be supposed to share in the phenomenon.

It was shown by Hale that sun spots have magnetic fields centered on the umbrae, which fields appear to derive from the rotation of charged particles. Sun spots, therefore, are vortices. However the vortex itself may be formed, the genesis of a spot appears to be as follows:

An ascending convection current, rising above the photosphere, reaches levels of reduced pressure where the top of the column expands. Heat is lost by expansion and the temperature of the expanded gas falls several thousand degrees relative to the photosphere. Its visible radiation decreasing proportionately, the cloud thus formed is seen as a relatively dark spot against the brilliant photospheric background. This constitutes the umbra of a sun spot. Surrounding it is a periphery of more diffused gases forming the penumbra. This penumbra is commonly and evenly striated and in most cases appears to slope inward and downward towards the umbra. Striation of the penumbra appears to be caused by currents flowing inward and outward to and from the umbra. Essentially, therefore, a sun spot is a funnel-shaped cloud roughly similar to a terrestrial tornado.

Bearing in mind the above facts certain striking metamorphoses are occasionally observed in the penumbrae of sun spots, difficult to explain on the assumption that such changes are real.

A spot is sometimes observed to lose its penumbra entirely on one side, retaining it on the opposite; and the lost portion is frequently regained. Other spots

are observed in which the penumbra alternately expands and contracts on both sides of the umbra. Since such changes are also frequently accomplished without any apparent effect on the striation of the penumbra, the question may be asked whether they are real or illusionary. The writer believes that all such changes, in which the striation is not affected, are only apparent and due to the masking effects of flocculi moving above the penumbra.

The striation of the penumbra may be used to separate real from apparent changes quite readily. Remembering that this whole structure is gaseous, it is clear that any profound alteration in the penumbra itself will certainly affect the striation by disturbing the currents which produce it.

Consider the case of a spot which suddenly appears to be dichotomized, say 24 hours after first observation, the penumbra appearing to vanish on one side while it remains whole and unaffected on the other and with no sensible disturbance of the striation in the visible half. Assuming such a change to be real we would have to believe that a vortex existed in which there was an indraught *only from one side,* an obvious impossibility.

The simplest explanation for such an appearance (by no means rare) is that some bright, opaque screen has come between the penumbra and the eye of the observer. This is most strongly suggested when the missing half of the penumbra reappears, the striation in the unaffected half meanwhile remaining undisturbed.

In order to cause apparent changes in the shape and area of the penumbra, without actually altering it physically, it seems clear that the agent effecting the apparent change must be in the nature of a screen superimposed upon but at a considerable altitude *above* the spot. Indeed the phenomenon is analogous to the projection of prominences on umbrae, which give rise to the bright bridges often observed; but the difference in volume between the slender umbral filaments and the obscuring masses which blot out whole areas of the penumbra make it fairly certain that the latter are floccular in nature. By learning to distinguish between physical changes in the penumbra and those caused by obscuring flocculi, it is thus possible to study their local movements by direct vision.

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American International Academy, Inc.,
Baltimore, Md.

PERTUSSIS IMMUNE ROOSTER SERUM

As a member of the American Association for the Advancement of Science I am greatly interested in the current article by Hilleman and Gordon in Science for October 15, 1943, relative to the preparation of a protective rooster antiserum against mouse pneumonitis virus.

I wonder whether or not the authors are familiar with the work of Dr. John Bailey, of the University of Indiana,[1] who in 1933 described an anti-serum of high potency produced in the rooster by repeated intraperitoneal inoculations of suspensions of live *H. pertussis.*

Bailey's serum was effective in alleviating to a considerable degree the paroxysmal cough in the early stages of pertussis in a limited number of children when administered intramuscularly. However, local reactions were at times severe and wide-spread usage of the serum was not attempted.

Three years ago I again became interested in the rooster as a possible source of immune serum particularly against type b *H. influenzae* for the treatment of influenzal meningitis in children, as past experience had demonstrated the failure of chemotherapeutic agents and antisera in the treatment of this disease. Approximately two years ago I submitted a problem to the research committee of the Michael Reese Research Foundation, Chicago, involving an attempt to produce a potent rooster immune against type b *H. influenzae* for the treatment of influenzal meningitis. The initiation of this work was curtailed when I entered the Army.

Ralph H. Kunstadter,
Major, M.C., AUS.
Ashford General Hospital,
W. Va.

A PROPOSAL CONCERNING THE KILGORE BILL

Because its arguments were based on generalities L. A. Hawkins (Science, January 14) criticizes my letter on the Science Mobilization Bill (Science, November 26, 1943). Since I was attempting to answer an earlier letter of Dr. Harlan T. Stetson (Science, October 22, 1943), to whose generalizations I objected, my reply was not an answer to specific objections to the bill.

Mr. Hawkins's interpretation of my remarks perverts my meaning and intention, perhaps because they were not clear. However, instead of offering specific answers to his specific objections to my general statements, I urge opponents and proponents of the bill to direct their efforts in exactly the manner he desires. If the less informed scientific public could have before it objective and specific analyses prepared by competent persons of divergent views, I believe the formulation of sound judgment would be hastened. I suggest, therefore, the publication and wide circulation of specific objections and specific answers to them.

[1] *Jour. of Infect. Dis.* 52: 97, 1933.

Such analyses should be in compact and understandable form and free from extravagant subjective opinion and emotional appeal.

I propose this in the interest of creating an informed opinion, though I do not concede the irrelevance or unimportance of certain far-reaching generalities that must form a background of any opinion that is reached.

LELAND H. TAYLOR
WEST VIRGINIA UNIVERSITY

SCIENTIFIC BOOKS

THE HISTORY OF BOTANY

A Short History of the Plant Sciences. By HOWARD S. REED. 323 pp. 37 figs. Volume VII of A New Series of Plant Science Books, edited by Frans Verdoorn. Waltham, Mass.: The Chronica Botanica Company. 1942. $5.00.

REED'S "Short History" is more than a dry record of progress. Through the kind and appreciative eyes of one of America's best-liked botanists the kaleidoscopic change in scenes and actors on the stage of botanical progress becomes a vivid adventure. This book will be enjoyed not only by professional botanists but also by students and others.

The first half of the book will appeal especially to those already versed in the history of botany, since it discusses many salient but generally neglected aspects of botany. Among these should be mentioned the chapters entitled "The Gardeners and Herbalists of Antiquity" and "Gardens and Other Things." In both of these the role of primitive agriculturists and horticulturists in the development of our knowledge of plants is stressed. Even though no written records of their activities are preserved, thus making the task of the historian difficult, their actual contributions, in the form of domesticated plants and cultural practices, are of such magnitude that our own work—although properly recorded and published—is dwarfed by them.

The middle portion of the book is most detailed, and the botanists of the seventeenth and eighteenth centuries receive considerable attention. This part conforms most closely to existing texts, but the evaluation of the work of these scientists is based on original research and is not a mere restating of current opinions. One might expect such conformity, since after more than 200 years the historian can estimate the influence of his predecessors with far greater certainty than that of more recent investigators in fields which are at present in a state of flux. In the latter case only a person actively engaged in research in such fields is in position to give a proper historical account, in which more than mere facts are recorded.

In the third part of the book a limited number of fields of research have been selected, and the development of each is traced to the present time. The choice of these fields was mainly determined by Dr. Reed's own interests and research activities, which are of a remarkably wide scope. In this manner plant geography, morphology, cytology, mycology, plant pathology and various plant physiological topics are dealt with in eleven chapters. Although some readers might wish the inclusion of certain other subjects, such as taxonomy, agriculture or growth and plant movements, the reviewer, for one, is glad that the author has chosen the adequate treatment of a selected number of subjects rather than an abbreviated encyclopedic treatment of all phases of botany. As it stands, the book is very readable and should be required reading for all more advanced students in biology. It gives a welcome addition to the diet of currently accepted facts on which most students are reared, and it will help in giving them a proper perspective, which becomes harder to attain as specialization progresses.

This book is thoroughly original, in scope and treatment as well as in illustrations. We do not find the traditional portraits of the paragons of science, which often are of questionable authenticity and usually are entirely non-committal as to the character of the subject. Instead, original illustrations of significant experiments, laboratories or publications are depicted, with delightful originality. One of the special values of the book is the adequate, though not undue, stress laid on the contributions of American scientists. The reviewer was surprised to find how seldom he disagreed with the author, which can only be attributed to the care with which Dr. Reed has considered each contribution and the sympathy with which he has treated each contributor. It is easier to criticize mistakes than to appreciate positive advances, which become incorporated in our general body of knowledge and which can be recognized as advances only after careful consideration.

The Chronica Botanica Company and its active editor should be commended for their initiative in bringing this book, for which a definite need existed, before the public.

F. W. WENT
CALIFORNIA INSTITUTE OF TECHNOLOGY

THE THEORY OF RINGS

The Theory of Rings: Mathematical Surveys, No. 2. By NATHAN JACOBSON. vi + 150 pp. New York: The American Mathematical Society. $2.25. 1943.

THIS is the second book in a new series of expository books entitled "Mathematical Surveys" which is edited and published by the American Mathematical

Society. The books of this series are expected to be authoritative and comprehensive within the field covered up to the time of publication. They will be of incalculable value to research mathematicians, who until the war were largely indebted to foreign publishers for such treatises. The present book by Jacobson is a worthy member of this series. It is not, however, recommended to the beginner.

The ring is the present evolutionary form to which linear algebras and hypercomplex systems are ancestral and of which they are special instances. The modern structure theory of linear algebras dates from the publication in 1907 of Wedderburn's thesis, and the structure of rings dates from Artin's paper of 1927. The representation theory of rings and their ideal theory is due to Emmy Noether and many other workers.

The author divides his subject into three parts: structure theory, representation theory and arithmetic ideal theory. In Chapter 1 he lays the foundations of the theory of endomorphisms of a group and throughout the book makes extensive use of the theory of rings of endomorphisms. By using the regular representations, the theory of abstract rings is obtained as a special case of the more concrete theory of endomorphisms. Moreover, the theory of modules, and hence representation theory, may be regarded as the study of a set of rings of endomorphisms all of which are homomorphic images of a fixed ring.

Chapter 2 deals with vector spaces and Chapter 3 with the arithmetic of non-commutative principal ideal domains. Chapter 4 is devoted to the development of these theories and to some applications to the problem of the representation of groups by projective transformations and to the Galois theory of division rings. The first part of Chapter 5 treats the theory of simple algebras over a general field; the second part is concerned with the theory of the characteristic and minimum polynomials of an algebra and the trace criterion for separability of an algebra.

The book is practically self-contained and embraces in its 150 pages a large amount of factual material. Such conciseness is obtained at the expense of elegance of typography, for many equations which would have looked better in displayed form have been run into the text. But this is a minor criticism of a book which is well planned and executed in a masterly manner.

C. C. MACDUFFEE

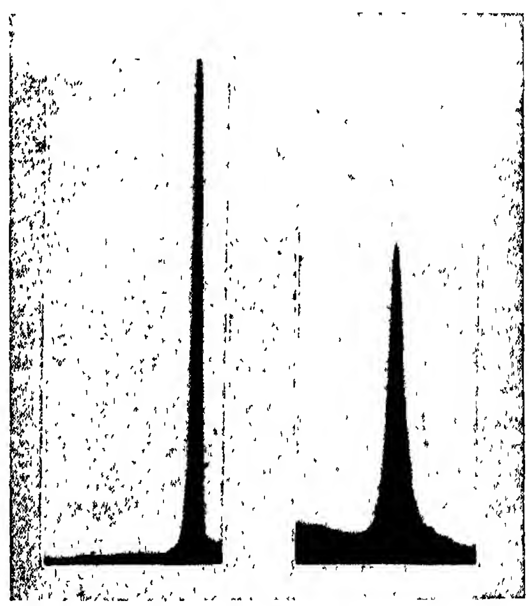
UNIVERSITY OF WISCONSIN

SPECIAL ARTICLES

THE ISOLATION OF PITUITARY GROWTH HORMONE[1]

IN this paper a method is described for the isolation of a protein from the anterior lobes of ox pituitaries which electively causes the resumption of body growth in hypophysectomized rats and which behaves as a single substance in electrophoresis.

The 2.0 *m* $(NH_4)_2SO_4$ precipitate of the $Ca(OH)_2$ extract[2] from the acetone dried powder of freshly dissected anterior lobes of ox pituitaries was made by a method previously described.[3] The precipitate was suspended in water and dialysed until free from electrolytes. The insoluble material after dialysis was dissolved in water and brought to pH 4.0 with 1.0 *m* HCl; a saturated NaCl solution was then added until the concentration was 0.1 *m*. A precipitate formed. The 0.1 *m* NaCl precipitate, found to be devoid of growth activity, was removed by centrifugation. The supernatant was brought to 5.0 *m* with solid NaCl,



(A) (B)

FIG. 1. Electrophoretic patterns of ascending boundaries of pituitary growth hormone preparations. (A) in pH 4.00 acetate buffer and (B) in pH 9.80 borate buffer after the current has been put on for 135 and 140 minutes respectively with a potential gradient of about 6 volts per cm.

[1] From the Institute of Experimental Biology, University of California, Berkeley. Aided by grants from the Rockefeller Foundation, New York City; the Josiah Macy Jr. Foundation, New York City; and the National Research Council Committee on Research in Endocrinology.

[2] All procedures were performed at 2 to 3° C.

[3] W. Marx, M. E. Simpson and H. M. Evans, *Jour. Biol. Chem.*, 147: 77, 1943.

and the precipitate formed was dissolved in pH 4.0. This NaCl fractionation was repeated twice. The final 5.0 *m* NaCl precipitate was dissolved in water and dialysed until salt-free. The dialysed solution was adjusted to pH 5.7–5.8 and the precipitate[4] formed was centrifuged off. The supernatant was then made alkaline and adjusted to pH 8.7–8.8, the precipitate[4] again being removed by centrifugation. The clear fluid was then next brought to 1.65 *m* $(NH_4)_2SO_4$ at pH 7.0. The $(NH_4)_2SO_4$ precipitate was dissolved in water and dialysed. The pH and $(NH_4)_2SO_4$ fractionation was repeated twice. The dialysed solution of the final 1.65 *m* $(NH_4)_2SO_4$ precipitate was made to pH 5.7–5.8. After the precipitate was removed by centrifugation, the supernatant was adjusted to pH 8.7–8.8. The precipitate formed was centrifuged off and the supernatant fluid brought to pH 6.8–6.9. The resulting precipitate was next dissolved in slightly acid solution and the isoelectric precipitation repeated twice.

The final pH 6.8–6.9 precipitate was examined in a Tiselius electrophoresis apparatus[5] using the scanning method of Longworth.[6] Experiments were carried out over a range of pH values from a pH 4.0 to 9.8 at a constant ionic strength of 0.10 using the acetate and borate buffers at 1.5°. In all these experiments the material appeared as a single substance (Fig. 1) with an isoelectric point at pH 6.85.

All biological assays were performed in female rats hypophysectomized at an age of twenty-seven days. Intraperitoneal injections were begun about fourteen days later, once daily for ten days. It was found that 0.010 mg of the hormone daily caused an increase of 10 gm in body weight. On the other hand, a total dose of 5.0 mg of the product did not show lactogenic, thyrotropic, adrenocorticotropic, follicle-stimulating or interstitial-cell stimulating activities, indicating that the preparation was substantially free of other biologically active pituitary contaminants.

Further physico-chemical and biological characterizations of this protein are in progress.

CHOH HAO LI
HERBERT M. EVANS

THE CHEMICAL REMOVAL OF SALTS FROM SEA WATER TO PRODUCE POTABLE WATER[1]

No method appears to be known for the chemical removal of salts from sea water; in fact, such a method has been considered impossible by some.[2] The method herein described should therefore be of interest. The general principle involved is the addition of a sufficient quantity of a suitable base to precipitate the anions present followed by the addition of a sufficient quantity of a suitable acid to precipitate the cations. The method actually used is a special case of this general principle in that both the base (Ag_2O) and acid (uric acid) used as precipitants are practically insoluble; this fact obviates the necessity of accurate measurement of these reagents.

The chemical reactions in the order in which they are carried out may be illustrated as follows:

$$(1)\ 2\,\overset{+}{Na} + 2\,\overset{-}{Cl} + Ag_2O + H_2O = 2\,\overset{+}{Na} + 2\,\overset{-}{OH} + 2\,AgCl$$

$$(2)\ \overset{+}{Na} + \overset{-}{OH} + \text{uric acid} = \text{Na-urate} + H_2O$$

The AgCl is filtered off before the addition of the uric acid. The solution is again filtered after reaction (2), the filtrate of which is nearly free of dissolved materials (see below). The reactions above are written for the precipitation of NaCl; but most of the other important salts present in sea water appear to react in the same manner. However Ca^{++} and Mg^{++} would also be partly or wholly precipitated as hydroxides in reaction (1). The sulfate ion would not be expected to precipitate since Ag_2SO_4 is fairly soluble.

The following data show the experimental procedure and typical results obtained with artificial (McClendon's) sea water:[3]

To determine how much of the total solids was urates and uric acid, a 20 cc portion of the filtrate from (3) was acidified with 1 N HCl to pH 3. A white precipitate soon formed. After standing a few

Solution	Amount (cc)	pH	Total solids (gms/100 cc)	Remarks
1. Art. sea water	1,000 cc	ca. 7	3.40	solution clear and colorless.
0.35 moles of Ag_2O added gradually over a period of about 20 minutes with stirring. Solution filtered immediately. Completion of reaction determined by persistence of brown Ag_2O in beaker.				
2. Filtrate from (1)	1,000 cc	10	2.17	solution clear; brown in color.
0.6 moles of uric acid added and solution stirred for about 20 minutes. Completion of reaction determined by noting fall of pH to near neutrality with indicator paper.				
3. Filtrate from (2)	790 cc	ca. 8	0.58	solution clear; sl. brownish.

[4] Both the pH 5.8 and pH 8.8 precipitates were found low in growth activity.

[5] A. Tiselius, *Trans. Faraday Soc.*, 33: 524, 1937.

[6] L. G. Longsworth, *Jour. Am. Chem. Soc.*, 61: 529, 1939.

[1] The manuscript of this article was received on January 30, 1943. Publication was postponed at the request of the committee on medical research of the Office of Scientific Research and Development.

[2] R. F. Braddish and others, *Jour. Am. Med. Asn.*, 120, 683, 1942.

[3] C. G. Rogers, Textbook of Comparative Physiology, p. 154. New York: McGraw-Hill, 1927.

minutes, the solution was filtered. The total solids determined on the filtrate was 0.45 gms 100 cc.

Discussion

Water yield. About 80 per cent. water recovery was obtained in the above experiment. The unrecovered water was retained in the urate precipitate. Additional water loss would occur if dry Ag_2O was used; for in the above experiment the Ag_2O was made from $AgNO_3$ and was not completely dry.

Toxicity. There is no reason to believe that the final product would be toxic. The small amount of dissolved materials (0.58 per cent.) is apparently composed of urates (0.13 per cent.) and an undetermined fraction (0.45 per cent.). This latter is probably sulfate (see above); since theoretically there should be 0.41 per cent. sulfate, calculated as Na_2SO_4, remaining in solution. In molarity, this is 0.029 moles per liter which is of sufficiently low concentration to serve as drinking water.

Taste. The water has a slightly salty taste and is not unpleasant to drink.

Summary

A simple chemical method is described for the removal of most of the salts from sea water. The final product, containing 0.58 per cent. dissolved material which is apparently composed of urates and sulfates, is not unpleasant in taste and is not expected to cause toxic effects if used as drinking water.

Acknowledgment

My thanks are due to Dr. J. C. Forbes, associate professor of biochemistry, for advice and encouragement and to Dr. L. D. Abbott, associate in biochemistry.

C. R. Spealman

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Richmond

A PRELIMINARY ELECTRON MICROSCOPE STUDY OF THE ACTIVE DEPOSIT FROM RADIOTHORIUM

Early investigations of the separation of active substances by the recoil method showed that a small quantity of the parent substance is always present on the collecting plate. One explanation of this phenomenon is that the active deposit consists of aggregates of atoms. When one of the atoms disintegrates by the ejection of an alpha particle the compact aggregate of atoms recoils. Some of the recoil aggregates are deposited on the collecting plate. Lawson[1] found conclusive evidence for the theory in a study of polonium active deposit and named the phenomenon "aggregate recoil." Chamié[2] proved the existence of aggregates in the active deposits of thorium, actinium and radium by her radioautograph technique. Harrington[3] also found evidence of aggregates in radium active deposit.

After repeating a Chamié radioautograph with an active deposit of thorium, a new technique, that of observation with the electron microscope, was used for a visual investigation of the nature of the active deposit. The usual specimen holder, collodion film supported on 200-mesh copper screen, was the surface on which the active deposit of thorium was collected. The screens were photographed in place in the microscope. The photographs were enlarged to give a final magnification of 80,000 × for convenient observation and measurement of particle size.

Samples which had been exposed to the emanations from radiothorium for three, five and eight days were observed. The three-day sample exhibited diffuse spots ranging in size from 20 to 50 millimicrons in diameter. The median diameter was 29 millimicrons. The particle size range of the five-day sample was from 12 to 50 millimicrons with a median diameter of 21 millimicrons. The particle size was much smaller on the eight day sample with a range of 10 to 27 millimicrons. The median diameter was 18 millimicrons. The density of the deposit increased with increasing time of exposure to the emanations. The relative densities expressed in number of particles per square centimeter are 1, 3 and 12 for increasing exposure time. After standing for eight days, the eight-day sample was rephotographed. A deposit of uniform density was observed.

The electron microscope photographs show the aggregates in the active deposit of thorium. The change in the nature of the deposit on standing and the relation of the size distribution of the aggregates to length of exposure to thorium emanations indicates that when an atom of the aggregate disintegrates by the loss of an alpha particle the recoil force is sufficient to cause the aggregate to break up scattering the atoms in all directions.

The same phenomena, though more spectacular, have just been observed for deposits from radon. Fairly large aggregates appear after 30 minutes exposure, while after 1 hour, extraordinary small (maximum about 50 Angstrom units), sharply defined particles appear in the electron micrographs.

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[1] R. W. Lawson, *Nature*, 102: 465, 1919.

[2] C. Chamié, *Compt. Rend.*, 186: 1838–40, 1928.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A NEW CONTACT LENS FOR VIEWING THE ANGLE OF THE ANTERIOR CHAMBER OF THE EYE

THE angle of the anterior chamber of the eye is hidden by opaque tissues and by total internal reflection at the outer surface of the cornea. It is possible to examine the chamber angle by use of a contact lens which eliminates internal reflection and creates a visual angle which passes behind the limbus.

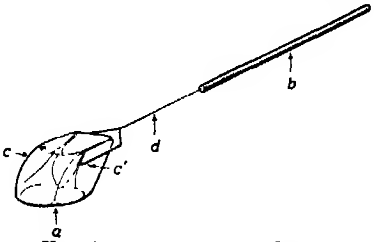

FIG. 1. A new contact lens.

A new instrument is introduced as an improvement over lenses now in use. As illustrated in Fig. 1, it consists of a new type of contact lens *a* and a handle *b* which are connected by a forked spring wire *d* pivoted at *c* and *c'*. This flexible spring wire permits the lens to be held in position without damage to the surface of the cornea. The lens is made of E. I. du Pont's plastic, H. C. 208 or of lucite, the former being preferable, since it does not scratch as easily, takes a finer optical surface and may be sterilized in boiling water. The quality of its internal reflection is excellent. Glass might be used but is heavier and more fragile than the plastics.

The concave contact surface, A (Fig. 2), of the lens has a diameter of 10 mm and a radius of curvature of 7.86 mm. Since the outer surface of the average cornea has a radius of curvature of 7.84 mm, a capillary film of tears forms between the lens and cornea when the two are in apposition (a drop of normal saline or other suitable solution may be used to wet the contacting surface of the lens before application). This film creates optical continuity between the contact lens and cornea and also serves to hold them together.

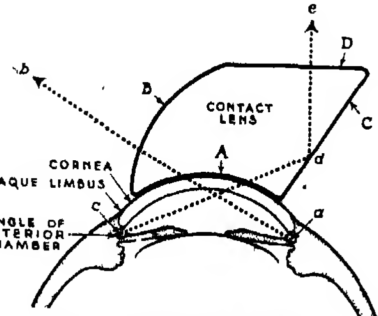

FIG. 2. A new contact lens.

When the lens is on the cornea (Fig. 2), a ray of light from a point *a* in the chamber angle is not reflected internally as before, but continues with little refraction to *b*. Refracting surface, B, which may be molded or ground with any desired magnifying power, is used with the loupe or unaided eye. On the opposite side of the lens, plane surfaces, C and D, form a reflecting prism. Reflecting surface, C, is not silvered; instead, total internal reflecting properties of glass or plastic are utilized. A ray of light from *c* is reflected at *d* to the observer at *e*. This prism is designed for use in combination with a standard slit lamp biomicroscope. The prism may be rotated on the cornea, and emerging rays, at any point in rotation, are directed toward the binoculars.

All other contact lenses used for this purpose depend upon the lids and sclera for support and include a deep liquid chamber between the lens and outer surface of the cornea. The lids frequently displace the lens, permitting air, which destroys optical continuity, to enter the liquid chamber. Furthermore, pressure of the lids, through the lens contact on the sclera, may create distortion of the tissues. For these reasons, only a few groups of workers have used gonioscopy routinely.

These objectionable features are not present in the new instrument; therefore, it is more practical for general clinical use.

Variations in lens surfaces and prism combinations are possible when the principles of the capillary film and the flexible supporting unit are used. Experiments with such variations are proposed and may be reported in the future.

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"THE DOCTOR'S DILEMMA" OR MEDICAL ETHICS IN PEACE AND WAR[1]

By Professor EDWIN G. CONKLIN

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SOME thirty years ago George Bernard Shaw, the famous English author and playwright, published a play entitled "The Doctor's Dilemma," which, like Molière's play, "Le Médecin malgré lui," has had a long and successful run on the stage. As in most of Shaw's published plays there is here a preface as long as the play itself in which the author condemns in wild but witty phrases current social conventions, and advocates Shavian Socialism as a cure-all. In "The Doctor's Dilemma" his unreal and emotional attack on medicine and science in general has just enough of truth in it to make it take with the general public. He denounces current medical ethics, pours contempt on the conscience of doctors, their assumed infallibility, their mercenary motives, their craze for surgical operations. He declares that doctors are not scientists, but pill dispensers and saw-bones; he denounces vivisection, and goes so far as to declare that bacteriology is a superstition, vaccination a craze, inoculations a public peril, and that doctors in general are animated with primitive savage and cruel motives. Finally the only remedy for this sad state of affairs is the "social solution" or the socialization of medicine.

The public, who see only the play on the stage and do not read the preface of the printed book, miss much of this diatribe, but they see Dr. Ridgeon of the play and his apprentice acting the part of Satan in the tangled human relations of greed *vs.* generosity, lust *vs.* love and murder *vs.* mercy.

My purpose in calling attention on this occasion to this and other absurd misrepresentations and exaggerations of the lack of ethics on the part of medical men is to contrast the high level of genuine medical

[1] Address at the graduation exercises in medicine, University of Pennsylvania, December 22, 1943.

ethics with the low level of social ethics in general. It has been popular for a long time in stage plays, such as "Le Médicin malgré lui," "The man who married a dumb wife," and many others, to poke fun at the pretensions and foibles of doctors and to shower contempt on their so-called ethics, but in reality the ethics of the medical profession in general is far and away higher and more ideal than the ethics of society as a whole, and it is certainly more realistic and at the same time more idealistic than that of any other profession, unless it be that of the minister of religion. From the beginnings of Greek medicine in the fifth century B.C. down to modern times the "Hippocratic Oath," named after Hippocrates, "The Father of Medicine," was taken by all persons entering upon the practice of medicine. This oath, in translation, reads in part:

> I swear by Apollo physician, and by Asklopias god of healing, and by all the gods and goddesses:
> To regard my teachers as equal to my parents.
> To help the sick according to my ability and judgment, but never to injure or wrong them.
> Not to give poison to any one, nor to cause abortion, but in purity and holiness to guard my life and art.
> Into whatsoever house I enter I will do so to help the sick, keeping myself free from intentional wrong-doing and harm.
> Whatsoever in the course of practice I see or hear that ought never to be published abroad, I will not divulge.
> Now if I keep this oath and break it not may I enjoy honor in my life and art among all men for all time;
> But if I transgress and foreswear myself may the opposite befall me.

Here is certainly a highly ethical professional code, and although candidates in medicine may not now be required to take this "Oath of Hippocrates," the profession as a whole is pledged to save life and to ease pain wherever this is possible, whether among friends or foes. The saving of life, like the saving of souls, is so much more important and vital than the saving of property or of social pride or of class and national prestige, that violations of humanitarian ethics on the part of physicians or ministers of religion are regarded as more reprehensible than in business or law or statecraft. The profession of medicine, like that of religion, is a humanitarian and holy calling and its ethical code is correspondingly high. These humanitarian professions point the way to better social and moral relations in all phases of society in the world to come after this great crisis in human history.

The contrast between the broad humanism of medicine and "the inhumanity of man to man" in many other social relations is most striking in times of war or preparation for war when the ethics of conflict justifies the wholesale slaughter of enemies and the saving and protection of friends only. This great contrast was nobly stated by Louis Pasteur, whom the French people have voted the greatest of Frenchmen, greater even than Napoleon, and of whom Sir William Osler, once professor of medicine in this university, said, "He was the most perfect man who ever entered the kingdom of science." Pasteur said in the concluding paragraph of his oration at the dedication of the Pasteur Institute in Paris on November 14, 1888:

> Two contrary laws seem to be wrestling with each other nowadays; the one a law of blood and death, ever imagining new means of destruction and forcing nations to be constantly ready for the battle field—the other a law of peace, work and health ever evolving new means of delivering man from the scourges which beset him. The one seeks violent conquests, the other the relief of humanity. The latter places one human life above any victory; while the former would sacrifice hundreds and thousands of lives to the ambition of one. The law of which we are the instruments seeks, even in the midst of conflict, to cure the sanguinary ills of the law of war; the treatment inspired by our antiseptic methods may preserve thousands of soldiers. Which of these two laws will ultimately prevail, God alone knows. But we may assert that French Science will have tried, by obeying the law of Humanity, to extend the frontiers of Life.

The law of humanity *vs.* the law of the jungle, the law of peace *vs.* the law of war, the law of health *vs.* the law of disease, the law of life *vs.* the law of death —there are no greater contrasts than these in all nature and in all human affairs! In all these opposing laws, ideals and goals, medicine is always on the side of humanity and the angels. Even in the midst of wars of the utmost destruction and even of wholesale extermination of armies, cities and nations, medicine has not heretofore been employed to destroy life but only to save it. There have been proposals to spread epidemics of diseases, to shower enemy armies and peoples with pathogenic bacteria and viruses, to poison food and water supplies, but none of these have ever been put into practice on a large scale. No doubt this is in large part due to the fact that epidemics are too likely to recoil on those who attempt to spread them, but it is also due to the fact that biology is the science of life rather than of death, and that medicine is by its very nature humanitarian rather than the opposite.

And yet military medicine is one of the very potent factors in modern wars, but it is always employed to save life rather than to destroy it. To be sure it is employed chiefly in saving the lives of friends rather than of enemies, but nowhere is the contrast greater between the humanitarianism of medicine and the inhumanity of war than in the medical and surgical treatment of wounded and helpless friends and foes.

This terrible conflict between the ethics of war and the ethics of medicine is especially confusing in totali-

tarian war, when whole nations, men and women and boys and girls are called upon to lend all possible aid and to give their very lives for the aims and ideals of the warring nations. Medical men have not been slow to take a leading part in this conflict. Everywhere they have given their utmost services for the success of the ideals which are at stake. The medical units which have gone out from this university have rendered most valuable services in many parts of the world; their members have labored and suffered for the cause which they represent. Those who have remained nearer home have labored with equal enthusiasm for the success of these ideals. Indeed this is a war of ideals rather than of nations, and nothing is more worth fighting for and dying for than our highest ideals. But now and always medical men recognize that above all ideals of merely national patriotism and prestige are the ideals of humanity. And so we find medical men laboring to save life and to ease suffering whether among friends or foes, thus giving practical expression to the ideal that "above all nations is humanity."

This war of ideals will be won by the better rather than by the worse, for humanism is more potent than nationalism; truth and justice and liberty more enduring than falsehood, injustice and slavery; love and peace more universally demanded than hate and war. The ethics of medicine is thus in a peculiarly favorable position to influence the peace and the state of society after the war, for if this war is not to be fought and won in vain, the ideals of humanity must prevail in shaping the peace and the world to follow.

The world needs more statesmen and lawyers and educators and public leaders with the realism and idealism of scientific medicine. Too long have our social leaders treated the ills of society as savage medicine men, witch doctors, magicians and plain fakirs once treated the diseases of the body, trying to charm away the symptoms rather than to remove the causes of diseases. The disorders and diseases of society have natural causes and these causes must be controlled if social health is to be restored. Wars and social revolutions are man-made and they can be man-cured. May the spirit and methods of modern medicine guide our national leaders in treating this sickness of society, and may the humanitarian ethics of medicine grow and expand in all human relations!

The current discussions concerning the relative merits of socialized medicine as contrasted with individual or private practice is not so much a question of aims and ideals as of means and methods. The aims and ideals of the medical profession are now and have always been essentially altruistic and humanitarian, but there are quite naturally differences of opinion as to the best methods of putting these ideals into practice. The real question is how the advances of medical science can be made most widely available to those who need them. There is no doubt that large numbers of people now suffer and die for lack of proper medical attention. How can this sad condition be relieved most satisfactorily? For several centuries western civilization has recognized the humane duty to care for the sick, whether they are poor or rich. Hospitals have been established for all classes and conditions of men at first by private charity and more recently by public taxation. Health and sanitation are now recognized as of such vital concern to society that they have been cared for by public means if private provisions have been insufficient or lacking, but the need of additional medical services is still very great. Society in general now realizes that the health of the people is as important as their education. Indeed in respect to the welfare of a nation medicine and education stand on essentially similar ground, both must be provided for, either by private or by public means.

Education was formerly a private and individual concern. Those who could not find means to attend private schools were compelled to remain unschooled. Then came the free school system, supported by general taxation, for all who were unable to attend private schools, or who preferred the public schools. Finally came universal compulsory attendance on schools, whether public or private. There are certain advantages of private schools over public ones. Pupils can usually have more individual attention from their teachers, schools can be chosen which are better suited to the individual peculiarities of pupils, the individuality of both pupils and teachers can be better safeguarded in private schools than in public ones. On the other hand, there are certain advantages in public schools, apart from their being available to all the people, for they place especial emphasis on training for the duties of citizenship and for the democratic way of life.

Similar conditions are found in the private as compared with the public services of medicine, and for the present, in both education and medicine, there is room and need for both private and public systems. But there are strong currents at present making for the greater socialization of both education and medicine. The Russian social revolution has affected all nations, and now this world-war for democracy and against autocracy and special privilege is likely to affect both education and medicine in a new world order after the war. We may expect that men and women who have served and suffered for the ideals of democracy will not readily abandon those ideals when they return to civil life.

Our leaders have assured us that we are fighting

for the four freedoms—freedom of religion and of speech, and freedom from want and from fear. Freedom from want means not only from want of food, clothing, shelter for all, but also freedom from the want of medical services for all who need them. Freedom from fear not only from fear of foreign aggression, but also from fear of poverty, sickness and helplessness. Through many centuries and in many countries this struggle for freedom has been going on and much progress has been made. The present world crisis is perhaps the greatest as it is certainly the most wide-spread of all the battles for freedom.

In the matter of freedom from the fear of many epidemics, such as smallpox, the black death, yellow fever, diphtheria, typhoid, etc., medical science has largely conquered helpless and irrational fear. Today fears of cancer, poliomyelitis, heart disease are wide-spread, but when their causes are more fully and generally known irrational fears will be relieved, even if their prevention and cure have not been solved. For example, in the epidemic of infantile paralysis in 1916 many towns and villages established shot-gun quarantine against all transportation of persons under sixteen years of age. In the 1890's similar quarantines were set up against all persons coming from yellow fever districts. Medical science has in large part removed such irrational fears even if it has not established unfailing cures of these diseases or means of their prevention. We fear most those things which are mysterious, "the pestilence that walketh in darkness," the causes of which are unknown.

But the want and need of medical attention and skill on the part of the population in general is more important than their relief from fears. The enormous amount of preventable sickness and incapacity for useful work is one of the greatest if not the very greatest of all social problems. This problem must be attacked realistically. In addition to private practice, supplemented by public hospitals and clinics, there must be increased facilities for taking the results of medical science to those who need them most, and if this is not or can not be done by the age-old method of private practice it will necessarily be done by some system of public or socialized medicine. For universal medical service is a social necessity and can not be indefinitely postponed.

I congratulate you who are to-day admitted into the ranks of this honorable profession. May you bring to it the skill and resources of modern science and the altruism and idealism which have made medicine a humanitarian profession and not merely a business or trade.

AGRICULTURAL RESEARCH IN THE WAR AND AFTER. II

By Dr. E. C. AUCHTER

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When Knowledge is a Matter of Life or Death

So much for the fruits of past research and the answer to my second question—What is agricultural research doing now?

More than any other crisis we have ever met, this war has proved that possession of scientific knowledge is a matter of life or death. As has been pointed out, it is not an accident that we are suddenly able to increase agricultural production beyond all previous records just when it is vitally necessary; that our soldiers and civilians are adequately fed for the strain of war; that we can develop scores of new techniques and products to meet specific needs and turn out the products in huge quantities. We can do these things only because science was not caught napping but was "tooled up" and had a stockpile of scientific knowledge and experience, patiently accumulated through many years of research—and enough well-developed techniques and trained personnel organized to tackle new problems with an excellent chance of success.

Nor could such a stockpile of scientific knowledge and the necessary techniques and trained personnel be improvised over night. We would not have them if it had not been for the support given to research pertinent to agriculture in this country during the past years and decades. The war has proved that no wiser investment was ever made by the American public.

There is a lesson in this for the future. I hope no one will ever again be tempted to doubt the value of research to the point where public support is reduced, so that vigilance slackens and effort lags. For though I hope we shall never have another great war, I am also certain that if we do have one, our success will again depend in no small measure on how well equipped we are with knowledge developed in times of peace.

It is well recognized to-day that research of all kinds will have to be enlarged and accelerated in every nation that hopes either to retain or to advance its present standard of living. Science truly is one of the great frontiers of a much shrunken world, and

any nation that neglects the exploration and development of this frontier is almost certainly hazarding its future—its potential share in the fruits resulting from technological advances, if not its independent existence.

Pooling Research Suggestions

There will be a great need of research in the years ahead. If each one of us here were to sit down and try to think of all possible fields for really fruitful research in the post-war period, and then pooled the suggestions, we would come out with an impressive list. Among many things with which we shall certainly be vitally concerned are these:

(1) Improved nutrition for human beings will be one of the great objectives of the future. Home economists, biochemists, physiologists and animal nutritionists have been among the pioneers in human nutrition. It must be one of their responsibilities to expand their research and continue to provide authoritative information in this field.

(2) In the broad field of plant and animal production, there will be many problems. It would be valuable to build up a detailed, systematic world geography of soils, climatic conditions, varieties of plants and methods of plant and animal production. Much of our knowledge of the development and growth of plant and animal organisms has come from agricultural scientists; we shall be expected to advance on that front, particularly in the direction of still greater control by such methods as breeding and the use of substances that regulate growth and functions. In this connection, world exploration to obtain and then maintain plant and animal germ plasm for breeding purposes will be of decided importance. We are likely to have abundant supplies of cheap nitrogen after the war; our crop rotations and systems of farming will need to be reexamined in the light of the changed fertilizer situation. In any future additional irrigation and drainage projects that may be developed, research by engineers, soil scientists and economists should be carried on in advance so that the causes of past failures may be avoided. The increasingly close contact between countries will mean new problems of insect, parasite and disease control; how can we cope with them, and in particular adapt for civilian use the revolutionary new methods of combating insects that have been developed during the war? Research is needed leading to the development of new and improved immunizing agents for many specific animal diseases.

The nutritional quality of agricultural products will receive increasing attention. We must follow up the promising leads we now have for improving nutritional quality by the proper choice of climate, soil management, cultural practises and plant breeding. We must also continue to investigate means of conserving such quality once it has been obtained. Only about half of all the milk solids dairy farmers produce are used directly as food for human beings; how to make it possible to use more of these valuable products is a problem of world-wide interest. There are literally thousands of identified species and strains of micro-organisms, many of which might be utilized to make valuable new pharmaceuticals, foods and industrial products; would it not be worth while to make a systematic survey of the possibilities in this field, extending the work already started with certain yeasts as relatively cheap sources of protein?

(3) Research in engineering and electrical and mechanical problems will be needed more than ever for such things as the perfection of home freezers, further improvements in refrigerated transportation, developing the possibilities in air transport of agricultural products, the use of the newer building materials for farm structures and improvements in the functional adaptation of farm buildings. Might it not be possible to develop complete sets of labor-saving machinery at reasonable prices for farms of different sizes and types? Although entirely an engineering problem, much will need to be done to develop dehydration, quick-freezing and canning of foods to meet the changed needs and conditions of the post-war world. And as home economists know, we have not yet reached the limit in developing labor-saving devices for the home.

(4) Many of the problems mentioned have both immediate and long-time aspects. In addition, there are many that will be urgent as soon as the war stops and that should be solved as far as possible before that time. For example, how can we best adapt for agricultural use certain equipment that will no longer be needed for military purposes? How can we best use training camp areas—land, buildings and other improvements—for agricultural and rural industries, and especially for aiding and training returning soldiers?

(5) Hundreds of millions of tons of crop residues are produced annually on the farms of this country. We should have a more vigorous research program to exploit this tremendous resource more intelligently for soil improvement, feed and such industrial products as building materials, fuel and chemicals. Some of the products developed might be made right on the farms while others could be the basis for local industries.

(6) Last, but surely not least, we need to think seriously about much more basic research in several fields of science. I need only to point out that our knowledge of such substances as starch, proteins, lignin, hemicellulose, enzymes, hormones and vitamins is still hardly more than rudimentary.

Have agricultural scientists expanded their field to the extent that the results of their research and their contacts with other fields justify? After all, if we find out how to produce excellent plant and animal products, should we not be interested in determining how to keep them excellent and in merchandising them properly until they are consumed by either rural or urban people? Are not the problems, incomes and activities of all people who use the products of the land of considerable importance to those concerned with production? Production, utilization and all that lies between are of one piece and we have not done our full duty until an integration has been effected. Past records of performance have demonstrated

clearly that both personnel and vision for such a task are available.

The list of suggestions just made is by no means exhaustive, but it does represent pressing and important lines of work. It would take careful thought, critical judgment and evaluation by many people of experience to determine what we need to do first and most after the war. Wartime developments and the prospective needs of farmers and consumers must be continuously weighed and considered. Thinking along that line is being done in connection with cooperative efforts at post-war planning, but as much attention must be given to the natural sciences as to economics.

Post-war planning in the social sciences is, of course, very important. Many urgent problems demand attention, such as those involving desirable adjustments in land tenure, cooperative institutions, shifts of population, improvement in marketing methods and various rural social institutions. The urgency of these problems, however, serves to emphasize the need for the closest possible integration of planning and research in all the sciences, natural and social alike, and a careful avoidance of too great compartmentalizing, or departmentalizing, of the planning and the implementing of the plans. There is also need for careful thinking and planning with respect to methods of extending the results of research to industry as well as to agriculture, particularly as they pertain to the utilization of farm products.

New Opportunities and Responsibilities

Agricultural research after the war can no longer be concerned with the needs of the United States alone; it must relate our needs to world conditions. This will be true whether or not there is close post-war collaboration among many countries. It will be doubly true if any such plans for cooperation are put into effect as those discussed at the United Nations Conference on Food and Agriculture held at Hot Springs earlier this year. The delegates at Hot Springs paid a great deal of attention to agricultural science. If a permanent organization results from the conference, as now seems likely, agricultural science must be given critical attention in its work.

I am not going to discuss the work of the Hot Springs conference except to point out briefly the bearing it may have on the development of agricultural research in the future. The essence of the recommendations made at Hot Springs is this:

Agricultural science has reached the point where we can say with some certainty that, given the right conditions, the world can produce enough food to eliminate starvation and raise populations to a considerably higher level of nutrition. At the same time, nutritional science has reached the point where we know what people need, not only to escape deficiency diseases but to bring about very great improvements in the physical conditions of masses of people in every country. What is needed to achieve these results—which are included in the broad objective of freedom from want—is closer integration of various aspects of agriculture and nutrition; the adoption by nations of food production and distribution policies aimed at getting adequate food to all their people; and collaboration among nations to achieve cooperative planning, expanded trade, and so on.

The Hot Springs recommendations envisage a gradual expanding of agricultural production all over the world, and this in turn would involve a gradual modernization of production methods, some reorientation of agriculture to produce enough of the foods needed, better distribution of agricultural products and comprehensive plans and studies to achieve better nutrition.

It would not be possible to do any of these things, and especially to expand, modernize and reorient production, without constant use of agricultural science. Knowledge of improved production, processing and storage methods, and assistance in adopting them, would have to become much more widespread, especially in certain countries. Research would be needed to solve scores of problems that would arise in every country and region. There would be a greater need than ever for scientists of high ability and capacity in various fields to serve in agriculture, where they would have opportunity and freedom to carry on research of the utmost significance to human welfare and would also be needed as consulting experts in the case of broad economic and social policies.

In other words, we are certain to have a world in which agricultural science will play an even more positive and dynamic part than it has in the past; and if recommendations such as those made at Hot Springs are carried out, even very gradually, by a permanent international organization, agricultural science will be consciously used, on a scale never before attempted, to help bring about world-wide freedom from want—and more lasting peace.

That will be both an immense responsibility and an immense opportunity to serve individual nations and mankind as a whole. Are we ready to accept such an opportunity? I believe we are. Agricultural science has done much to shape the world we live in. It is playing an important part in the solution of our present problems. It is ready, able and eager to make the greatest possible contribution in the post-war world.

OBITUARY

JOSEPH JASTROW
1863–1944

JOSEPH JASTROW, emeritus professor of psychology at the University of Wisconsin and widely known as a psychologist, died in his eightieth year at Stockbridge, Massachusetts, on January 8, 1944. He was born in Warsaw, Poland, on January 30, 1863, the son of the Reverend Marcus and Bertha (Wolfsohn) Jastrow.

He was graduated at the age of nineteen in 1882 from the University of Pennsylvania, from which institution he also was granted a master's degree in 1885. In 1885 he held a fellowship in psychology at the Johns Hopkins University, where the first laboratory of psychology in America and the second in the world had been organized two years before. He received his doctor's degree in 1886. Two years later he married Rachel Szold, a devoted helpmeet until her death in 1926.

He was called to the University of Wisconsin in 1888 as professor of experimental and comparative psychology (the title soon changed to professor of psychology) with instructions to organize a psychological laboratory. Virtually all his long service as a teacher was given to this institution, though he held a lectureship at Columbia University in 1910, and, on his retirement from the University of Wisconsin in 1927, was a lecturer in the New School for Social Research in New York City for six years from 1927–1933. He was in charge of the psychological section of the World's Columbian Exposition at Chicago in 1893. At the opening of the psychological laboratory at Wittenberg College in 1928, the degree of LL.D. was conferred upon him.

Professor Jastrow was a charter member of the American Physiological Society organized in 1887 and was the next to the last of its living founders. He was a fellow of the American Association for the Advancement of Science and vice-president of Section H in 1891. He was one of twenty-six charter members of the American Psychological Association organized in 1892 and its first secretary, 1892–1893. He was elected president of the association in 1900 and in his presidential address selected and defended two problems of psychology as of the greatest significance; the study of animal behavior as the primer of human behavior, and applied psychology "not for analysis alone but for practical yardstick purposes." He emphasized the wide extension of measurements of mental processes and capacities beyond psychophysics and reaction time, the study of abnormal psychology for the light it might throw on normal phenomena, and the admission of psychology on an equality into the fraternity of sciences. Of the two major problems the second engaged his interest and attention throughout his life and notably in the sixteen years after his retirement from the University of Wisconsin as an active teacher, as is indicated in the many volumes that he published.

Professor Jastrow possessed a keen, incisive mind and an extraordinarily facile pen. In addition to numerous and frequent contributions to scientific journals on psychological problems and joint authorship in several monographs, he published the following books: "The Time Relations of Mental Phenomena," 1890; "Fact and Fable in Psychology," 1900; "The Subconscious," 1906; "The Qualities of Men," 1910; "Character and Temperament," 1915; "The Psychology of Conviction," 1918; "Keeping Mentally Fit: A Guide to Everyday Psychology," 1928; "Piloting Your Life: The Psychologist as a Helmsman," 1930; "Effective Thinking," 1931; "The House that Freud Built," 1932; "Wish and Wisdom," 1934; "Sanity First," 1935; "The Story of Human Error" (editor and contributor), 1936; "The Betrayal of Intelligence," 1938.

In the last volume there appears what seems to have been the keynote of his life as a psychologist in the injunction, "Be critical—critical in what you accept, critical in whom you follow as authority." He was early an ardent foe of pseudo-scientific applications of psychology as is indicated in one of his best-known books, "Fact and Fable in Psychology." The volumes since 1928 grew out of syndicated newspaper articles and adventures in broadcasting, giving critical and sound advice on psychological matters. He was equally vigorous in his criticism of "isms" in psychology and the various so-called schools of psychology that did nothing but create confusion and chaos. In recent years he also sketched but did not fully expound a naturalistic conception of psychology based on the known or reasonably conjectured facts of neurology which he hoped would bring cosmos out of the present persisting chaos. It is a matter for regret that he did not elaborate his "naturalistic approach and scheme of psychology" for which he expressed great hope and confidence.

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RECENT DEATHS

DR. SANFORD R. GIFFORD, since 1929 professor of ophthalmology at Northwestern University, died on February 25. He was fifty-two years old.

THE REVEREND FRANCIS JAMES DORE, S. J., head of the department of biology of Boston College, died on February 28 in his sixty-eighth year.

Dr. Frank Lawrence Cooper, instructor in physics at Yale University, died on February 25 in his sixty-ninth year.

Dr. Harry Fletcher Brown, vice-president of E. I. du Pont de Nemours and Company, who from 1904 to 1911 was director of the department for smokeless powder, died on February 28 in his seventy-seventh year.

Perley J. Buchanan, director of Process Development and Chemical Control of the American Agricultural Chemical Company, died on February 23 at the age of sixty years.

Dr. James Brodbeck, president and chairman of the board of the Society of Chemical Industry at Basle, Switzerland, died on February 26 at the age of sixty-one years.

SCIENTIFIC EVENTS

SCIENTIFIC RESEARCH AND INDUSTRY IN GREAT BRITAIN

Recommendations are made by the London Chamber of Commerce in a report on scientific and industrial research, which was adopted at a recent meeting. *The Times*, London, states that

The report was submitted by a special committee, appointed on June 8 last year, "to ascertain in what manner the chamber could assist in promoting research in industry." The chamber has reached the conclusion that in order to galvanize research in this country into full and fruitful activity there are three basic essentials: A centralized and planned direction, through a Central Research Board, a far greater stream of money flowing into research, and a larger, better trained, and better paid staff.

The report suggests that the proposed Central Board should act as a coordinating and directing body for all research organizations, and be the link between the Government and the research activities of the country at large. The need for better facilities for specific research on behalf of the small firm is held to be evident.

The Central Research Board should have the right to intervene and require research associations, in consideration of the public funds placed at their disposition, to undertake fundamental research in directions which it judges to be in the national interest, and to require greater activity on the part of associations, which, in its view, are proving unequal to their responsibilities. It should be the duty of the board to consider the effect on national trade and industry as a whole of discoveries of a fundamental nature, and to direct the use of those discoveries so that they may be of the maximum advantage to the nation.

Dealing with finance, the Chamber believes that the universities, as the bodies entrusted with the vital task of carrying on pure research, should maintain a far larger staff than at present of graduates and of skilled laboratory technicians. It is recommended that the number of research followships at the universities should be substantially increased.

The Chamber strongly supports the Parliamentary and Scientific Committee in its recommendation that a sum of £10,000,000 should be spent over the first five post-war years in equipping and enlarging university laboratories, and that the program, estimated before the war to cost £12,000,000, to increase the provision of technical and art colleges and to expand and bring up-to-date those already in existence, should be carried out.

EXHIBIT OF THE ACADEMY OF SCIENCES OF THE U.S.S.R. AT THE LIBRARY OF CONGRESS

An exhibition portraying the history and activities during the last twenty-five years of the U.S.S.R. Academy of Sciences has been placed on display in the Library of Congress.

Founded by Peter the Great in 1724, the academy to-day consists of approximately 136 academicians, more than 30 honorary academicians, about 224 corresponding members and over 5,000 scientific and technical assistants. Sixteen American scientific workers are now honorary or corresponding members of the academy. The portraits of some of the more prominent academicians have been included in the exhibition through the cooperation of the Embassy of the U.S.S.R. Representative volumes of the more important works by members of the academy have been selected for display from the extensive collection of Russian materials in the Library of Congress, probably the richest to be found in any library in the Western Hemisphere.

The organization of the academy groups its activities in eight departments, to each of which a section of the exhibit is devoted: the departments of physico-mathematical, chemical, geology-geographical, biological and technical sciences; history and philosophy, economy and law, and language and literature. Under these eight departments, the academy maintains 76 institutions, 11 laboratories, 47 stations, 6 observatories and 24 museums. There are also eight branches of the Academy of Sciences throughout the Soviet Union, under the supervision of which are 39 institutes, 28 stations, 3 astronomical observatories, 8 botanical gardens, 3 sanctuaries and 17 other scientific research establishments. The exhibit includes publications issued by each of the departments of the academy and some of its branches.

The peace-time work of the academy was suddenly interrupted on June 22, 1941, when Germany invaded Russia. From the very beginning of the invasion,

the academy readjusted its activities to place its resources fully behind the war effort. Even while Moscow was under heavy German attack, the publication of journals and texts was continued. Books printed while the city was under Nazi bombardment are among those shown in the display.

Under the direction of the academy, chemists have pioneered in manufacturing synthetic rubber, in photochemistry, in developing winter lubrications for tanks and planes, in producing new explosives and in extending the uses of helium. Soviet geologists have turned their energies to the problem of supplementing the stock of raw materials required by the Russian war machine, and agronomists have increased the productivity of agriculture. Physiologists and physicians have won international fame for their treatment of shock, tetanus, gangrene and other war maladies, and dietitians have found new nutritive substances, as well as new sources of vitamins, which have been used to help to solve the food problems resulting from the war. Technologists have also scored notable successes in finding substitutes for scarce materials, in simplifying technological processes and perfecting the organization of war industries. Most of these activities are represented in one way or another by publications on display.

Exhibited items of particular interest include the first book published by the academy in 1728 at St. Petersburg, the "Commentarii academiae scientiarum imperialis petropolitanae," pictures of the first building of the academy in Leningrad, its present home in Moscow, to which it moved in 1934, and the architect's drawing of its proposed new building; numerous publications of various scientific establishments attached to the general assembly and current periodicals concerning the academy as a whole. It is interesting to note that, while the publications are published mainly in Russian, a number have been published in English as well, while others have titles and summaries in English. M. V. Lomonosov (1711–1765), whose portrait appears in the historical section of the exhibit, is described as "probably the most interesting figure in the whole existence of the academy."

AWARDS OF THE BRITISH GEOLOGICAL SOCIETY

It is reported in *Nature* that the Council of the Geological Society has announced the following awards:

The Wollaston Medal to Professor V. M. Goldschmidt, professor of geology, Frederiks University and Museum, Oslo, for his outstanding contributions to Norwegian petrology, and his fundamental researches into the structure of crystals and the distribution of the chemical elements in the earth.

The Murchison Medal to Professor V. C. Illing, of the Imperial College of Science and Technology, for his talented contribution to oil geology and Palaeozoic stratigraphy.

The Lyell Medal to Dr. N. R. Junner, of the Geological Survey of the Gold Coast and Sierra Leone, for his contributions to the stratigraphy of the Pre-Cambrian and his discoveries of valuable minerals associated therewith.

The Wollaston Fund to A. G. Brighton, curator of the Sedgwick Museum, Cambridge, for his services to paleontology and his researches on the echinoderms.

The Murchison Fund to G. M. Stockley, of the Geological Survey, Tanganyika Territory, for his work on the stratigraphy, paleontology and mineral resources of East Africa.

The Lyell Fund, one moiety to Dr. S. Buchan, of the Geological Survey of Great Britain, for his work on underground water resources of the London area, another moiety to E. W. J. Moore, of Haslingden, for his researches on carboniferous goniatites.

IN MEMORY OF CHARLES BENEDICT DAVENPORT

The Executive Committee of the board of directors of the Long Island Biological Association, at its meeting on February 28, 1944, passed the following resolution:

Be it resolved, That the directors of the Long Island Biological Association record with a sense of irreparable loss the death, on February 18, 1944, of Dr. Charles Benedict Davenport.

Among the foremost of American men of science, Dr. Davenport was for forty years a resident of Cold Spring Harbor. From 1898 until 1923, he served as director of the Biological Laboratory, and from 1904 until 1934 as director also of our neighbor organization, the Department of Genetics of the Carnegie Institution of Washington. To a greater extent than any other individual, he was, indeed, the founder of both these institutions.

Retirement from executive responsibility brought no slackening in the interest and labor of Dr. Davenport for the cause of the Biological Laboratory. Throughout periods of discouraging outlook, of disappointment and deep personal sorrow, no less than during the happier years, he held faith in the importance and assured success of our common aim. As Secretary of the Board from 1923 until his seventy-eighth year, Dr. Davenport maintained his health and enviable vigor, his sound judgment, foresight, complete self-effacement. Among all his fellow-workers and neighbors his memory will stand no less for high attainment than for an abiding example of integrity, helpfulness and warmth of heart.

Be it further resolved that a copy of this resolution be sent to the members of Dr. Davenport's family.

The Executive Committee decided also to ask the members of the association, as well as friends and colleagues of Dr. Davenport, for contributions to a Charles Benedict Davenport Memorial Fund, the interest of which will be used for aiding scientific research in the biological field.

SCIENTIFIC NOTES AND NEWS

On the occasion of the one hundred and forty-ninth anniversary of the founding of Union College the doctorate of laws was conferred on Joseph W. Barker, dean of the Faculty of Engineering of Columbia University, special assistant to the Secretary of the Navy.

An honorary doctorate of engineering was conferred on Charles F. Wagner, manager of the central station engineering department of the Westinghouse Electric and Manufacturing Company, at the fiftieth anniversary convocation on February 21 of the Illinois Institute of Technology. The citation reads: "For pioneering research in the application of symmetrical components to power system analyses; for his outstanding contributions to the modern theories of synchronous and induction machine performance; and for his leadership in the investigation of natural lightning phenomena and the application of knowledge regarding lightning to the protection of electrical systems."

Dr. William M. Whyburn, professor of mathematics at the University of California at Los Angeles, has been elected a correspondent of the National Academy of Exact, Physical and Natural Sciences of Lima, Peru.

The Council of the Royal Aeronautical Society, London, has elected Group Captain F. Whittle a fellow of the society, in recognition of work of great importance in aeronautics.

Sir Henry Dale, president of the Royal Society, director of the laboratories of the Royal Institution, London, was presented on January 13 with the Hanbury Memorial Medal of the British Pharmaceutical Society.

The honorary gold medal of the Royal College of Surgeons, London, was presented at the Buckston Browne luncheon at the college on February 12 to W. H. Collins, chairman of King Edward VII Hospital, Windsor, in recognition of his gift of £100,000 to endow the department of pathology, with provision for a further like sum to extend and develop the department of pathology at Lincoln's Inn Fields and to found there a chair of human and comparative pathology.

The Harrison Lectureship Medal was presented on February 10 to Dr. Arthur James Ewins, F.R.S., at the House of the Pharmaceutical Society of Great Britain. Following the presentation Dr. Ewins delivered the Harrison Memorial Lecture on "Progress and Problems of Chemotherapy."

P. M. S. Blackett, F.R.S., Langworthy professor of physics in the University of Manchester, has been appointed president of the British Association of Scientific Workers, which now has a membership of nearly 15,000.

Dr. Frank S. Lloyd, professor of education at New York University and executive director of the division of physical fitness of the Federal Security Agency, has been appointed chairman of the department of hygiene of the College of the City of New York.

Dr. Kenneth C. Reynolds, associate professor of hydraulics in charge of the river hydraulic laboratory of the Massachusetts Institute of Technology, known for his work in hydraulic engineering, has been appointed head of the department of civil engineering at Cooper Union with the rank of professor. He succeeds Professor Edward S. Sheiry, who has resigned. Dr. Reynolds is now on leave of absence from the Massachusetts Institute and is in charge of a special investigation of waves for the Bureau of Ships under the Oceanographic Institution at Woods Hole.

At Temple University, Philadelphia, Dr. Wilbur Emory Burnett, professor of clinical surgery at the School of Medicine, has been appointed professor of surgery to succeed Dr. William Wayne Babcock, who has become professor emeritus; Dr. Thomas Harold Davis has been appointed to succeed Dr. Robert F. Ridpath, professor of laryngology and rhinology; Dr. John Franklin Huber to succeed Dr. John B. Roxby, professor of anatomy; Dr. Robert H. Hamilton, Jr., to succeed Dr. Melvin A. Saylor, professor of physiologic chemistry; Dr. Morton J. Oppenheimer to succeed Dr. Joseph G. Hickey, professor of physiology, and Dr. Lowrain E. McCrea to succeed Dr. William Hershey Thomas, professor of urology.

Dr. R. V. Truitt has resigned as professor of zoology and agriculture at the University of Maryland to devote his full time to the enlarged program of the Department of Research and Education at Solomons Island, Md., of which he is director.

Dr. Michael Levine, biologist in charge of the Cancer Research Laboratory of Montefiore Hospital, New York, has been appointed assistant director. He assumed his new work on March 1.

Dr. William H. Headlee, head of the division of tropical medicine and parasitology at the School of Medicine of Indiana University, Indianapolis, will leave during the present month to conduct a study of tropical diseases in Guatemala, Honduras and Costa Rica, under the auspices of the Association of American Medical Colleges and the Markle Foundation in cooperation with the army medical corps.

At the Kansas State College, Dr. H. E. Myers, pro-

fessor of soils, has leave of absence for two years to serve as agricultural adviser to the State Department. In his absence Hugh G. Myers, agent for agronomy at the Garden City Substation, has been made associate professor of soils. Dr. Roger C. Smith, head of the department of entomology, has leave of absence to serve as allocations specialist in the biological sciences and agriculture for the War Manpower Commission.

THE second annual Robert J. Terry Lecture of the Dr. William T. Coughlin Foundation was given on December 21 in the auditorium of the St. Louis Medical Society by Dr. Henry Pinkerton, professor of pathology in the School of Medicine of St. Louis University. His subject was "Typhus, Rocky Mountain Spotted Fever and other Rickettsial Diseases."

PROFESSOR HARLEY J. VAN CLEAVE, of the department of zoology of the University of Illinois, was the speaker at the science section of the Oklahoma Education Association, which met in Oklahoma City from February 16 to 18. His address was entitled "Returning Service Men—A Threat to National Health." He also gave an illustrated lecture on the "Biological Aspects of Conservation."

DR. OTTO LOEWI, research professor of pharmacology at the New York University College of Medicine, delivered on March 28 the Rothschild Lecture at Beth Israel Hospital on "The Chemical Transmission of Nervous Impulse."

DR. HENRY R. KRAYBILL, director of the research laboratory of the American Meat Institute, professorial lecturer at the University of Chicago, will lecture for the Ontario Research Foundation at the March meeting of the Toronto Chemical Association. His lecture will be entitled "The Spectral Analysis of Fats."

SIR HAROLD SPENCER JONES, Astronomer Royal of Great Britain, will deliver the 1944 May Lecture of the Institute of Metals. His subject will be "Metals in the Stars."

THE Friday evening discourses for the present season at the Royal Institution, London, include one on "Brain Rhythms" by Professor E. D. Adrian, F.R.S.; one on "The Medical and Surgical Achievement of Soviet Russia in War," by E. Rock Carling, and one on "Habit and Evolution," by Professor D. M. S. Watson, F.R.S. In addition the following courses of lectures have been announced: "Modern Developments in Dairy Science," by Professor H. D. Kay; on "Fungi and Modern Affairs," by J. Ramsbottom; on "The Mode of Action of Some Vitamins," by Professor A. R. Todd, F.R.S.; on "Chemical Factors in Nervous Effects," by Sir Henry Dale, P.R.S.; and on "Food Fads and Food Fallacies," by Sir Jack Drummond.

THE Rockefeller Foundation has made an appropriation of £1200 for bio-chemical investigations of penicillin under the direction of Professor Howard Walter Florey, F.R.S., professor of pathology at the University of Oxford.

TWENTY-TWO postgraduate fellowships for research in the field of chemistry for the academic year 1944–45 have been provided by E. I. du Pont de Nemours and Company. Appointments to these fellowships, which amount to $750 each, will be made later in the year by the heads of the departments of chemistry of the several colleges and universities to which grants have been made.

GRANTS amounting to $35,600 have been made by the Research Foundation of the Ohio State University, of which Dr. A. R. Olpin is executive director, to stimulate and foster research in the basic sciences. These are $10,000 for Research Foundation fellowships in the Graduate School; $10,000 for research on nuclear x-ray sources; $5,000 for research in applied mathematics; $5,000 for research in electronics; $5,000 for surgical and medical research; and $600 for a technical assistant in zoology and entomology. The Research Foundation was established in 1937 as a non-profit corporation, to serve as a contractual and administrative agency for researches conducted under contract in university laboratories, with both private and government support. It also handles all patent matters for the university. The foundation has acquired control of many valuable inventions of a patentable nature and has licensed manufacturers to operate under the patents. Income from royalties and other earned income is set aside in a research reserve to foster new cooperative research programs.

POST-WAR plans for teaching and research in tropical medicine are now being formulated at the DeLamar Institute of Public Health of the School of Medicine of Columbia University, of which Dr. Harry S. Mustard is director. A substantial beginning has been made, further expansion is looked for in the near future, and peace-time developments comprehend new buildings, laboratories and an expanded faculty. An intensive program of graduate instruction in tropical medicine is being provided this spring, and it is expected that in the near future a full year's work will be offered to properly qualified students. In a statement issued by Dr. Mustard he points out that as a component of the College of Physicians and Surgeons, the DeLamar Institute of Public Health provides a foundation for tropical medicine that is essential. There is already available most of the basic resources necessary. In addition, Columbia University, through its relationships with the School of Tropical Medicine in Puerto Rico, is in position to provide advanced students with intensive work in a tropical environment.

THE results of a nutrition survey of Palestine are described in *The Lancet*. The survey shows that there is little obvious undernourishment in Palestine. A Health Department Survey has already shown that part of the urban population is suffering from malnutrition due to poverty. The rural population is believed to be better off now than ever before. The survey is covering the whole country and taking account of both Jewish and Arab communities; it is linked with the school-feeding scheme for Arab children in the larger towns. Children of both groups have suffered more from malnutrition than adults. The most serious dietary deficiencies are of fats and calcium, especially among Arab children. The Jewish school-feeding scheme has improved the nutrition of poor Jewish children and it is hoped that the government plan for providing school meals for Arab children will have an equally good effect. There was less vitamin deficiency than had been expected, since vegetables and fruit in season offer a good source of many of them. Iron deficiency is commoner among the Jews than among the Arabs, who use more iron-containing plants in cooking. An educational campaign, to encourage vegetable growing and conservative cooking, is proposed. Poor housing and high rents contribute to poverty and hence to malnutrition.

DISCUSSION

A NOTE ON THE SEROLOGICAL ACTIVITY OF DENATURED ANTIBODIES

ERICKSON and Neurath have recently given a brief account[1] of their studies of the change in activity, as shown by the precipitation reaction with the homologous antigen SSSI, of horse antipneumococcus antibody when subjected to the denaturing action of guanidine hydrochloride. They observed that their preparations after treatment with the denaturing agent were able to form precipitates with the homologous antigen. They attributed this ability to the regeneration of antibody in the absence of antigen, and suggested that this indicates that "the difference between antibody globulin and normal globulin is not merely one of steric arrangement but probably one of amino acid composition." We believe that a reasonable alternative interpretation of the experiments can be given.

The argument of Erickson and Neurath depends on the implied assumption that in their experiments all the antibody activity of the preparation was initially destroyed by the denaturing agent. This assumption, however, is not supported by direct experimental evidence. Our interpretation of the observations, which does not include this assumption, is the following: We assume[2] that parts of the antibody molecules have such a folding of the polypeptide chains as to give them structures complementary to the homologous antigen, and that the specific activity of the antibody resides in these parts. Under the influence of a denaturing agent such as guanidinium ions an antibody molecule may undergo structural change (unfolding of polypeptide chains, breaking of hydrogen bonds, "denaturation") in any one of many different ways, some of which may and others may not affect the parts of the molecule with specific combining power for antigen; thus the molecule may undergo "denaturation" either with or without destruction of its specific combining regions. Unfolding of polypeptide chains, whether or not it affected the specific combining regions, would lead to some polymerization and decreased solubility; and accordingly it is not a sound assumption that, if antibody structure is due to specific folding of polypeptide chains, decrease in solubility must be accompanied by loss of antibody activity.

On this interpretation the "regenerated antibody" of Erickson and Neurath would consist of those antibody molecules which had escaped extensive unfolding under the action of the denaturing agent, whereas the "irreversibly denatured antibody" would consist of aggregates of partially unfolded molecules, of such size as to be insoluble in saline solution at the isoelectric point but soluble in 2 per cent. sodium thiocyanate solution. The power of combining with antigen shown by each of these fractions we attribute to the presence of undestroyed specific combining regions on the molecules or aggregates. Evidence indicating that the process of destruction of the specific combining regions of antibody molecules by denaturing agents is slow has been obtained in an experimental study of the destruction by urea of the antitoxin activity of diphtheria antitoxin which has been in progress in these laboratories during the past year; an account of the results obtained so far will be published soon.[3]

This picture of the phenomenon suggests that changes should occur in the combining ratio of antibody and antigen, as observed by Erickson and Neurath. It is clear from this point of view that the amount of specifically precipitable protein in a treated antibody preparation can not be taken as a true mea-

[1] J. O. Erickson and H. Neurath, SCIENCE, 98: 284, 1943.

[2] See L. Pauling, *Jour. Am. Chem. Soc.*, 62: 2643, 1940.

[3] G. G. Wright, *Jour. Exp. Med.*, in press.

sure of the number of undestroyed specific combining regions, that is, of the remaining antibody activity. It is our opinion that methods such as the neutralization of toxin by antitoxin are more satisfactory than the precipitation reaction for following the destruction of antibody activity.

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GENERAL BIOLOGY

THE discussion of Report number 15, of the U. S. Office of Education, in a recent number of SCIENCE,[1] brings into contrast two points of view about "biology." Professor Alexander no doubt believes that biology is some sort of unit in the fields of knowledge. Biology has often been represented to be a subject similar to chemistry, with various aspects, to be sure, just as in the case of chemistry. All the discussion of general biology, as contrasted with other sciences, shows a fundamental misconception of its nature. The existence of the word "biology" does not mean that there is a well-unified science which can be so designated. Biology can not be set down beside chemistry, physics, mathematics, etc., as on an equal footing with them. The term which is correlative to "the biological sciences" is "the physical sciences." Would it be an improvement to the teaching of physics, chemistry, mathematics, meteorology, geology, astronomy, etc., to concoct an extraction of all of them, and present it as a preferred introduction to those fields?

Most of us from our own experience must believe that it is necessary to treat mathematics by itself, as perhaps the most fundamental science; and that the other physical sciences are best presented in major courses dealing with their own material in their own way. They do not neglect mathematics, but supplement it, and put it to use in innumerable ways. The biological sciences have long been sinned against, even by our highest bodies of scientists, by trying to coerce them into some kind of hodge-podge unit. It is an encouraging sign that the U. S. Office of Education has found courage to print the report of the committee. Too long have the courses in general biology been a fraud against the student. Botany is a unified subject, coordinate with chemistry. Zoology also is a unified subject coordinate with chemistry. Either of these life sciences has as many subdivisions of its material as are found in *Chemical Abstracts*, for instance.

A better day will dawn for the biological sciences when it is fully recognized that there is no such thing as a science called "biology," any more than there is a science known as "physical science." These expressions represent great groups of sciences, and it is no wiser to present "general biology" instead of botany and zoology, than to present "physical science" in lieu of mathematics, physics and chemistry. The general biologists have been fooling themselves and the world of education far too long.

[1] SCIENCE, n. s., 99: 78–80, 1944.

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APPEARANCE OF MENDEL'S PAPER IN AMERICAN LIBRARIES

THERE has been considerable interest among geneticists since the turn of the century in the "rediscovery" of Mendel's epoch-making studies of the laws of inheritance. Mendel's well-known paper, "Versuch Ueber Pflanzen Hybriden," was published in Volume 4 of the Naturforschender Verein, Brünn, Austria, in 1865. It would be interesting if we knew all the reading Mendel did of the writings on inheritance and also the contacts he made both personally and by letter with contemporary scholars interested in heredity. Morgan (SCIENCE, page 262, 1932) rightly places emphasis upon what had been learned as to the inheritance of characters in the pea by Goss and Knight 42 years before the above paper by Mendel was published. Naudin's studies also antedate Mendel's work by two years or so.

Mendel's paper apparently remained unknown to most of that group of European workers in near-by countries who would have best understood the significance of his results. It remained for the geneticists of a later generation to find and evaluate Mendel's work. Frequent mention has been made of the "rediscovery" of Mendel's paper in 1900 by deVries, Correns, Bateson and Tschermak. To the credit of American geneticists note should be made of the fact that L. H. Bailey included a reference to Mendel's work in a paper on cross breeding and hybridizing in 1892. DeVries learned of Mendel's work from this bibliography (see "Plant Breeding," by Bailey and Gilbert, page 155, 1915). Bailey was using the Harvard Library from 1881 to 1885 while working with Asa Gray but had learned of Mendel's work from reading Focke rather than from seeing Mendel's paper direct.

Since one sometimes detects a slight note of reproach from American geneticists because European workers had overlooked Mendel's work for so long it occurred to the writer that it would be of interest to know when and where Mendel's paper might have been available in American libraries before 1900. To this end it was noted that in the second edition of the Union List of Serials (1943) 21 libraries list Volume 4 of the Brünn Society. Inquiry by letter to each of these libraries as to the date Volume 4 was available

for reference brought out the following rather surprising situation:

Academy of Natural Sciences of Philadelphia	1867
American Academy of Arts and Sciences, Boston	1867
Boston Society of Natural History	1867
U. S. Army Medical Library, Washington, D. C.	1871
Harvard University Library	1878
Yale University Library	1882
Library of Congress and Smithsonian Institution	1883
U. S. Department of Agriculture, Library	1896
New York Public Library	1897
Columbia University Library	1898

This list may not be complete and does not, of course, include possible personal copies which may have been sent at that time direct to individual American scientists.

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CONTINUATION OF THE PROGRAM OF THE INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE

IN 1943, the writer published "An Index to the Opinions of the International Commission on Zoological Nomenclature."[1] Publication of the index was preceded by an extended correspondence (1934 to 1943) with the late Dr. Charles Wardell Stiles, formerly secretary of the commission, and officials of the Smithsonian Institution, which published Opinions 1 to 133. Typescript of the index was placed in the hands of the publishers early in March, 1943, and the material was in type when SCIENCE for July 2, 1943, carried the first note which had come to the writer's attention regarding continuation of the Opinions by the International Commission through its publication office in London.

In a letter from Mr. Francis Hemming, secretary of the commission, under date of January 4, 1944, the writer's attention was directed to certain statements in the introduction to the index which were held to contain "inaccurate and damaging statements regarding the position of the International Commission." The statements thus referred to included an honest, if possibly unsound, expression of doubt as to the possibility of future continuation of the programs of the congress and the commission because of factional difficulties which seemed to threaten effective operation of either the congress or its commission on nomenclature. Evidence to the contrary was not available at the time the manuscript was prepared.

It is now obvious that the obstacles to further cooperative effort were not insurmountable. The commission began an independent program of publication of additional opinions in 1939, and thanks to the industry and vision of the members of the commission, and especially its secretary, Mr. Hemming, "The Bulletin of Zoological Nomenclature" was established in 1943 as a clearing house on problems of zoological nomenclature.

The university library placed a standing order for both the *Bulletin* and the *Opinions* immediately upon receipt of information regarding their availability in July, 1943, but because of obvious transportation difficulties the first issues of the *Bulletin* were received in November and the first shipment of the *Opinions* came through in January.

Through the *Bulletin* it is a matter of record that beginning in 1939 an active program of publication of *Opinions* beyond the 133 incorporated in the index was well under way and that by October, 1943, *Opinions* 134 to 147 had been issued and eleven additional opinions rendered by the commissioners had not yet been given publication. However, knowledge of the existence of the *Bulletin* and of the start of the new volume of *Opinions* was not generally available to American zoologists until the July 2, 1943, issue of SCIENCE carried the memorandum by Dr. James E. Peters.

It is with the deepest appreciation that American zoologists view the continuation of the international cooperation in nomenclature. Any misleading statements which the writer may have made regarding cessation of such activity were unintentional reflections of personal opinion, inadvertently inaccurate because facts to the contrary were not available at the time the Index was prepared.

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[1] *Amer. Midland Nat.*, 30(1): 223–240.

SCIENTIFIC BOOKS

GARDEN ISLANDS

Garden Islands of the Great East. Collecting Seeds from the Philippines and Netherlands India in the Junk "Cheng Ho." By DAVID FAIRCHILD. 239 pp. Many illustrations. New York: Charles Scribner's Sons. 1943.

THE reviewer of David Fairchild's new book is somewhat in the position of one required to describe, in prose, the merits of a poem. It is impossible, in a brief account, to do justice to the excellence of the narrative and the interest of the topic. The Malay Archipelago of Wallace, in spite of all the changes due to man, still includes many islands, and parts of islands, in their original condition, full of new or little-known plants and animals. The Malay flora is extraordinarily rich in species of woody plants, and

as regards its genera and larger groups is of great antiquity. The fossil fruits of the London Clay in England, dating back many millions of years, show that formerly many of the plants growing on the islands of the East were represented in Europe by unmistakable relatives. Climatic changes have driven this flora to a more limited region, while the multitude of islands has favored the development of many local species.

Fairchild supposed that his collecting days were over, but his friend, Mrs. Archbold, became interested in a collecting expedition to the Moluccas, and it was arranged for Thomas Kilkenny to build a Chinese junk in Hongkong, in which they would explore the islands, searching for plants and seeds, to be grown in the warm parts of North America, especially Florida. The project was to be kept secret even from their intimate friends, but it leaked out and many letters came warning the Fairchilds against making such a dangerous journey at their age. They felt, however, that precisely because they were older the world could spare them more easily if they never returned. As it turned out, there were no very serious dangers or discomforts, and they managed to get out, sooner than they had intended, before the Japanese invasion. They gathered over five hundred different kinds of plants, including over ninety species of palms. The region, in strong contrast with Africa, is extremely rich in palms, and as so many of these will now be grown from seed in Florida, it will be possible to study their characters very much better than could be done from herbarium material. "Already the Fairchild Tropical Garden boasts a collection of about 250 species of palms . . . a Palm Products Museum . . . and the Liberty Hyde Bailey Palm Glade is in the making."

After a brief visit to Japan, the Fairchilds went to the Philippines. Three chapters are entitled "Thatched Cottage in the Philippines," "With the Foresters of Luzon" and "Highland Sojourn." The junk came to Manila, and at the beginning of 1940 they were off to the islands known collectively as the Netherlands Indies, visiting the southern Philippines on the way.

"The Isle of Singing Children" describes a visit to the islands of Siaoe, which appears as a tiny dot on the chart, yet has on it volcanoes 5,800 and 3,600 feet high. The Radja gave a song festival in honor of the Fairchilds:

> I was not present, but Marian reported that when her turn came she could not think of a single song, and to cover her embarrassment, the Radja's wife started "Merrily we roll along," and the whole company carried it on in English. What made it surprising was that the guests were all natives of Siaoe. There wasn't a European on the island. . . . As the *Cheng Ho* bore us out past the smoking cone of Goenoeng Api, and past Mt. Tamata, the sweep of coconut landscape was so beautiful, the memories of our stay among the charming people were so pleasant, that I think all of us felt we would like to return sometime to the island of the singing children. Are they still singing under Japanese invasion, I wonder? Where they came from, these light-colored, gay-people, nobody knows.

So on to Celebes, to Java, to Bali, to Amboina and other places, always with exciting plant discoveries and charming human contacts. The famous botanical garden at Buitenzorg in Java was of course visited. Here it was that Fairchild, a young man of twenty-five, first worked in the tropics, "and now, in April of 1940, I was walking there alone, forty-six years later and on my seventy-first birthday." While Fairchild collected plants, Mrs. Fairchild and Mrs. Archbold collected shells. The large collection of shells was taken to the Museum of Comparative Zoology at Harvard University, and will undoubtedly prove of great scientific interest.

As we read about these lovely islands, and their marvelous flora, they seem to belong to another world. Yet with modern means of transportation, they can be reached in less than two weeks from the United States, and no doubt will be once the war is over. There is some danger here, that the wrong people may go. The Fairchilds, in their attitude toward the inhabitants, their pleasure in the scenery, their understanding of the plants, were just the people to get the most out of such a journey; there is perhaps no one living who could equal them. It should be one of the prime aims of education to cultivate understanding and appreciation of foreign lands and a love of the beauties of nature.

The very numerous illustrations in the book, from photographs, help us to understand the text; they are selected from some thousands taken. The book closes with these words, written in the early dawn at Miami:

> The birds are twittering in the trees. The scene before me changes every moment. And there is Marian, standing beside me. Dawn has broken, and we sit and think of those other dawns in the other places of the earth where we have been. We are back home again among the living souvenirs of our years of travel, and knowing that we must close this book we have written, Marian suggests that we might close it here where we began it—under the Java Ficus tree where now one of those carved stone images of Bali has found a resting place.

Perhaps the old man only fell asleep and rambled through the "Groote Oost," and, waking, found that what he told about was nothing but a dream.

T. D. A. Cockerell

Desert Museum,
Palm Springs, Calif.

SOCIETIES AND MEETINGS

HONORS AND PRIZES OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS

ONE of the colorful events which always dignifies the annual meetings of the American Society of Civil Engineers is the presentation of honors and prizes. The event this year occurred on Wednesday morning, January 19, 1944, in the auditorium of the Engineering Societies Building, 33 West 39th Street, New York City.

The first prize awarded was given to Thomas E. Stanton, recently vice-president of the society, for his paper on "Expansion of Concrete through Reaction between Cement and Aggregate." This prize is the oldest and highest within the gift of the society. It has been awarded for over sixty years. Mr. Stanton's paper dealt with the physical consequences that may result from chemical reaction between high alkali cement and certain mineral constituents of aggregate. It provides an adequate explanation of a number of startling cases of concrete deterioration that have occurred in coastal regions. The engineering profession, the concrete industry and the users of concrete in general are benefited by the studies recognized in the award of this prize.

Next in the list of prizes was the J. James R. Croes Medal, named in honor of the first winner of the Norman Medal. This year the medal was awarded to Carl R. Gronquist, associate member of the society, a bridge engineer with the New York firm of Robinson and Steinman. His contribution was entitled "Simplified Theory of the Self-Anchored Suspension Bridge," and appeared together with other prize-winning papers in the 1942 volume of the society's "Transactions." The type of structure described differs from the ordinary suspension bridge in that the horizontal pulls of the cables at the ends are resisted by the structure itself rather than by the abutments. The new theory lends itself to a straightforward and expeditious analysis. Although the suspension bridge has occupied the spotlight during recent years, the self-anchored form has not enjoyed great prominence because of the complexity of its analysis. Mr. Gronquist's work, therefore, is of practical and immediate value.

Next was the Thomas Fitch Rowland Prize, named for its donor, a former officer of the society, to memorialize outstanding papers describing construction of engineering works. It was awarded this year to Paul Baumann, member of the society, for a paper on "Design and Construction of San Gabriel Dam No. 1." Because of the scarcity of dam sites distinctly favorable for masonry structures, engineers are faced more and more with the problem of constructing dams at locations far from ideal. The solution in the case considered by Mr. Baumann was an adaptation of a type known as the rock-fill dam to meet special local conditions. In addition to a discussion of design and construction, he gave a full analysis of the materials and correlated his laboratory tests with actual field construction experience to an admirable degree.

Another experience with a dam was illustrated in the award of the James Laurie Prize, which was given to Thomas A. Middlebrooks, associate member of the society, for a paper on the "Fort Peck Slide." Perhaps no part of the technical responsibility of the American Society of Civil Engineers is so important as the free and open discussion of civil engineering failures. This paper is based on tests and analyses conducted on the soil and rock at the dam site, as bearing on the disastrous slide that occurred in September, 1938. The particular value of the paper is in that it focuses attention on the results of studies conducted after the slide to determine its cause and to outline a method of repair.

The Arthur M. Wellington Prize commemorates one of the society's great thinkers in the field of transportation and economics. This award went to Milton Harris, associate member of the society, for a treatment of the topic, "Traffic Engineering as Applied to Rural Highways." This paper sets up basic points of view relative to the modernization of highway facilities as well as the design of new highways, showing that the engineering study should recognize the practical use of the highway as well as the engineering provision for specific needs utilizing stated materials. Major Harris, formerly of the California Department of Highways, is now in service in North Africa.

Somewhat different in character is the Collingwood Prize for Juniors, limited to the younger members of the society. The winners were Ray K. Linsley, of the U. S. Weather Bureau in Sacramento, and William C. Ackermann, of the Tennessee Valley Authority, Knoxville, Tenn. Their joint paper was entitled "Method of Predicting the Runoff from Rainfall." The subject is one of much interest to engineers. The merit of the paper lies in the fact that it develops methods of computing values of runoff in advance, which agree quite favorably with the observations for actual storms. These researches therefore have a practical application.

The Construction Engineering Prize is under the construction division of the society and is awarded yearly for the best paper on construction appearing in

the society's journal, *Civil Engineering*. Carlton B. Jansen, member of the society, engineer of the Dravo Corporation in Pittsburgh, received the award for a most interesting paper on "Submerged Shipways with Steel Sheeting Walls," describing a recent installation of great engineering interest in Wilmington, Del.

Another prize under the auspices of a society division rather than the society as a whole is the Karl Emil Hilgard Prize, in memory of a celebrated Swiss engineer who lived for many years in America. The hydraulics division of the society determined that this prize should go to Professor Harold A. Thomas, member of the society, of the Carnegie Institute in Pittsburgh, and Emil P. Schuleen, associate member, of the U. S. Engineer Office, in the same city. Their paper was entitled "Cavitation in Outlet Conduits for High Dams." Cavitation is the mechanical deterioration, in this instance of concrete, due to high water pressures and velocities. Two types of apparatus for studying cavitation are described, with analysis of the results, and a development of the hydraulic theory involved.

The last award for engineering studies was made to George J. Schroepfer, member of the society, chief engineer of the Minneapolis-St. Paul Sanitary District, for a paper entitled "Experiences in Operating a Chemical-Mechanical Sewage Treatment Plant." This paper received the Rudolph Hering Medal at the hands of the sanitary engineering division of the society. This medal commemorates a famous American engineer. The paper describes the problems that arose in the first two years of operation of a new plant, the expedients developed to overcome the difficulties, and further changes to effect economy or simplification. The results have a direct appeal to sanitary engineers faced with similar practical problems.

Four celebrated American engineers were awarded honorary memberships, highest recognition among American civil engineers. Best known of these men was Thomas H. MacDonald, for many years head of the government roads program, now the Public Roads Administration in Washington. Another well-known engineer is Francis T. Crowe, who has been construction superintendent on Boulder, Shasta and other huge western dam projects. Gerard H. Matthes is well known among American civil engineers for his outstanding work in the fields of river hydraulics, surveying and geology. Still another new honorary member is Edward H. Connor, long a leader in the field of large bridge construction and difficult deep foundations.

In their presentation for these distinguished honors, the new honorary members were accorded the following citations:

EDWARD HANSON CONNOR: Long a leader in the contracting field, attacking difficult bridge and foundation problems; whose character and integrity have earned success in a most hazardous engineering business.

FRANCIS TRENHOLM CROWE: Construction engineer specializing in tremendous dams; whose masterworks have brought protection to flood-stricken valleys, vital power to great industrial centers and life-giving water to a thirsty land.

THOMAS HARRIS MACDONALD: Pioneer in American transportation engineering, devoting a lifetime to distinguished public service; through whose clear vision and administrative powers the world's greatest highway development is being consummated.

GERARD HENDRIK MATTHES: Happy combination of Dutch and American training; master of many engineering fields, now lending great talents to solving the hydraulics of the Mississippi River; cultured gentleman who honors a great profession.

At the same meeting the following newly elected officers were installed: *President*, Malcolm Pirnie, New York City; *Vice-Presidents*, Richard E. Dougherty, New York City, and Franklin Thomas, Pasadena, Calif.; *Directors*, S. C. Hollister, Ithaca, N. Y.; Gail A. Hathaway, Washington, D. C.; R. W. Gamble, Milwaukee, Wis.; Wilbur M. Wilson, Urbana, Ill.; Frank C. Tolles, Cleveland, Ohio; William D. Shannon, Seattle, Wash., and Royce J. Tipton, Denver, Colo.

SYDNEY WILMOT,
Manager of Publications

SPECIAL ARTICLES

THE POSSIBLE SYNTHESIS OF BIOTIN FROM DESTHIOBIOTIN BY YEAST AND THE ANTI-BIOTIN EFFECT OF DESTHIOBIOTIN FOR L. CASEI[1]

RECENTLY the yeast-growth-promoting activity of desthiobiotin has been described, together with an improved method for its preparation from biotin by hydrogenolysis with Raney nickel.[2] Desthiobiotin was found to be equally as effective as biotin in stimulating the growth of *Saccharomyces cerevisiae*, but could not replace biotin as a growth stimulant for *Lactobacillus casei*. These differences in the growth-stimulating properties of biotin and desthiobiotin for

[1] The authors wish to express their appreciation to Mrs. Glenn Ellis and Miss Carol Tompkins for carrying out the bioassays.

[2] V. du Vigneaud, D. B. Melville, K. Folkers, D. E. Wolf, R. Mozingo, J. C. Keresztesy and S. A. Harris, *Jour. Biol. Chem.*, 146: 475, 1942. D. B. Melville, K. Dittmer, G. B. Brown and V. du Vigneaud, SCIENCE, 98: 497, 1943.

yeast and *L. casei* suggested their utilization as a differential biological assay method for the determination of biotin and desthiobiotin in systems containing either or both compounds.

The surprisingly high yeast-growth activity of desthiobiotin raised the question of whether desthiobiotin was a yeast-growth factor *per se* or showed activity because of a conversion to biotin by the yeast cell. With a differential assay method available it became possible to investigate this problem, and the results of some experiments in this direction are described herein.

TABLE 1

YEAST AND L. CASEI ASSAY VALUES OBTAINED WITH BIOTIN AND DESTHIOBIOTIN, SEPARATELY AND IN COMBINATION, AND AFTER AUTOCLAVING IN ACID SOLUTIONS

Growth stimulant added	Total amount of stimulant added	Yeast assay biotin and desthiobiotin values	L. casei assay biotin values
		γ	γ
Biotin	1.00 γ	1.01	1.02
Desthiobiotin	1.00 γ	1.00	0
Biotin 0.5 γ, Desthiobiotin 0.5 γ	1.00 γ	0.96	0.52
Biotin, autoclaved*	1.00 γ	0.98	0.96
Desthiobiotin, autoclaved*	1.00 γ	0.37	0
Moist yeast, autoclaved*	1.0 gm	0.72	0.67
Desthiobiotin, Moist yeast, autoclaved*	6.33 γ, 1.0 gm	2.12	0.67

* 1 hour at 120° C with 2 *N* H_2SO_4.

The growth effects of pure biotin and desthiobiotin, alone and in combination, were first determined on cultures of *S. cerevisiae*.[3] A mixture of biotin and desthiobiotin showed an additive effect on the growth of this yeast, as shown in Table 1.

Biotin and desthiobiotin, singly and in combination, were tested for their growth effects on *L. casei* ε[4]. At concentrations of desthiobiotin lower than 0.47×10^{-7} molar, the growth produced by mixtures of the two compounds was identical with that produced by the biotin present alone, as shown in Table 1. This permitted the use of this method for differentiating between biotin and desthiobiotin in mixtures of the two.

However, it was observed that at concentrations of desthiobiotin higher than 0.47×10^{-7} molar, desthiobiotin possessed a definite anti-biotin effect toward *L. casei*. The growth of this organism due to 0.82×10^{-10} molar biotin was decreased to one half its value by the addition of 2.3×10^{-6} molar desthiobiotin prior to incubation. This inhibition of growth by desthiobiotin was completely reversed by increasing the biotin concentration to 4.1×10^{-10} molar. The use of the yeast-*L. casei* differential method of assay for desthiobiotin in biological materials is not complicated by the anti-biotin effect of desthiobiotin if the concentrations of desthiobiotin are not greatly in excess of 0.47×10^{-7} molar. In the following experiments sufficiently low concentrations of desthiobiotin are used to prevent the anti-biotin effect from playing an appreciable role in the assays.

Since preliminary acid hydrolysis was used to liberate any bound biotin in the yeast cultures, the effect of acid hydrolysis on the activity of desthiobiotin and of desthiobiotin and yeast mixtures was investigated. These results, also included in Table 1, show that while treatment of biotin with 2 N H_2SO_4 at 120° for 1 hour has no effect on its growth-promoting activity, the same treatment of desthiobiotin destroys between 60 and 80 per cent. of its yeast-growth activity. It is evident from these results that in fractions exhibiting growth activity for *L. casei*, and not affected by acid hydrolysis, this activity could not be due to desthiobiotin, but could be due to biotin.

In experiments designed to determine the possible formation of biotin from desthiobiotin used as a growth stimulant for yeast, 40 cc of biotin-free medium were inoculated with 2.4 mg of moist yeast from 24-hour culture of *S. cerevisiae* (Strain 139) and added to various amounts of desthiobiotin in 125 cc pyrex Erlenmeyer flasks. These cultures were incubated at 30° C. for either 16 or 48 hours. At the end of the incubation period, the cells were separated from the medium by centrifugation. The medium was autoclaved without acid for 15 min-

TABLE 2

DATA OF SEVERAL TYPICAL DESTHIOBIOTIN CONVERSION EXPERIMENTS

Compound added	Amount added	Inoculum per 40 cc.	Incubation period	Yeast assay (biotin plus desthiobiotin)			L. casei assay (biotin)			Amount of desthiobiotin converted
				Cells	Medium	Percentage of amount added	Cells	Medium	Percentage of amount added	
	γ	mg.	hrs.	γ	γ	Per cent.	γ	γ	Per cent.	Per cent.
Desthiobiotin	0.1212	2.40	16	0.1130	0.0025	95	0.1130	< 0.0008	93	100
Desthiobiotin	1.212	2.40	16	0.1315	1.016	95	0.1540	< 0.0008	13	13
Desthiobiotin	1.212	2.40	48	0.185	0.889	90	0.210	< 0.0025	18	18
Biotin	0.1217	2.40	16	0.1212	< 0.0004	99	0.100	< 0.0008	83	..

[3] E. E. Snell, R. E. Eakin and R. J. Williams, *Jour. Am. Chem. Soc.*, 62: 175, 1940.

[4] G. M. Shull, B. L. Hutchings and W. H. Peterson, *Jour. Biol. Chem.*, 142: 913, 1941.

utes, while the cells were autoclaved at 120° C. for 1 hour in 2 N H_2SO_4. The solutions from the autoclaved cells were neutralized, adjusted to volume and filtered to remove any precipitate. Both the autoclaved medium and the acid-hydrolysed cells were assayed for yeast-growth-promoting activity, which represents activity due to both biotin and desthiobiotin, and *L. casei* growth-stimulating activity, which is a measure only of biotin or some other biotin vitamer which has been synthesized by the yeast and which is capable of supporting the growth of *L. casei.*

The data of several typical desthiobiotin conversion experiments together with a biotin control are presented in Table 2. These results show that desthiobiotin disappears from the incubating yeast cultures and is replaced by an equivalent amount of a substance possessing growth-promoting powers for *L. casei.* The most logical assumption is that desthiobiotin is transformed to biotin by the growing yeast cell.

As can be seen in Table 2, the conversion of desthiobiotin is not complete with increasing amounts of desthiobiotin added, even with the longer incubation period. Apparently only sufficient amounts of desthiobiotin are converted to supply the needs of the growing cells. This is also borne out by our finding that resting yeast did not convert any measurable amount of desthiobiotin to biotin. Increased concentrations of other components of the growth medium did not affect the conversion. The use of such a biological synthesis of biotin, from the relatively easily synthesized desthiobiotin, on a preparatory scale might be feasible with micro-organisms which could convert larger amounts of desthiobiotin to biotin.

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THE ANTI-BIOTIN EFFECT OF DESTHIOBIOTIN[1]

ACCORDING to Melville, Dittmer, Brown and du Vigneaud[2] *Lactobacillus casei* does not grow when desthiobiotin replaces the biotin of the medium, whereas *Saccharomyces cerevisiae* strain 139 grows readily. Through the courtesy of Dr. R. T. Major, of Merck and Company, the writers secured a sample of desthiobiotin and by using 45 biotin-requiring organisms confirmed and extended the findings of Melville *et al.* The results show that the biological effect of desthiobiotin could be classified into the following four groups according to the responses of the individual organisms:

1. *Desthiobiotin replaced biotin* for 25 strains of *Saccharomyces cerevisiae*, for *Saccharomyces chaudati*, *S. macedoniensis*, *Endomycopsis fibuliger*, *Debaryomyces matruchoti v. subglobosus*, *Mycoderma valida*, *Mycotorula lactis*, *Schizosaccharomyces pombe*, *Torula lactosa*, *Zygosaccharomyces marxianus*, *Zygosaccharomyces lactis*, *Neurospora crassa*, *N. sitophila*, *Ceratostomella ips 438*, *C. Montium* and *Leuconostoc mesenteroides*.

2. *Desthiobiotin did not replace biotin* for *Ceratostomella pini* 416, *Sordaria fimicola*, *Lactobacillus casei*, *L. arabinosus* and *Rhizobium trifolii* 205.

3. *Desthiobiotin did not act as anti-biotin* in the presence of an exogenous supply of biotin for *Lactobacillus arabinosus* and *Rhizobium trifolii.* These were not inhibited by 1,000 micrograms of desthiobiotin and 0.025 microgram of biotin per liter; in fact, *L. arabinosus* showed nearly a threefold increase in growth over the controls, and a still greater growth when desthiobiotin was augmented to 4,000 micrograms per liter. This stimulation may be ascribed to one of the following two causes: either this organism is able to utilize a certain amount of desthiobiotin in the presence of biotin, or else the sample of desthiobiotin at our disposal carried biotin as impurity. However, it is doubtful if there was enough biotin to support so much growth, otherwise why did this organism fail to grow when no biotin was added to desthiobiotin?

4 *Desthiobiotin acted as anti-biotin* for *Sordaria fimicola*, *Ceratostomella pini* 416 and *Lactobacillus casei.* The first one of these three organisms may be considered a borderline case: it averaged 45 milligrams of dry mycelium per flask in the presence of 0.1 microgram of biotin per liter; when 250 micrograms of desthiobiotin was added to this amount of biotin, the yield went up to 83 milligrams, but when desthiobiotin was increased to 4,000 micrograms per liter and the amount of biotin remained the same, the yield dropped back to 44 milligrams per flask. *Ceratostomella pini* 416 showed a more clear-cut effect of anti-biotin action. It averaged 34 milligrams of dry mycelium per flask in the presence of 0.25 microgram of biotin per liter; upon the addition of 2 micrograms of desthiobiotin per liter, the yield increased to 50 milligrams per flask. But when desthiobiotin was increased to 1,000 micrograms per liter, the yield dropped to 12 milligrams per flask.

Table 1 gives the responses of *Lactobacillus casei* in detail.

Failure of *Lactobacillus casei* to grow whenever

[1] Published with the approval of the director of the West Virginia Agricultural Experiment Station as Scientific Paper No. 326.

[2] D. B. Melville, K. Dittmer, G. B. Brown and V. du Vigneaud, SCIENCE, 98: 497, 1943.

TABLE 1

THE GROWTH OF LACTOBACILLUS CASEI IN THE PRESENCE OF VARYING AMOUNTS OF BIOTIN, DESTHIOBIOTIN, AND COMBINATIONS OF THE TWO, AFTER 72 HOURS AT 37° C.

Micrograms biotin per liter	Photometer readings	Micrograms desthiobiotin per liter	Photometer readings	0 025 micrograms biotin per liter, varying amounts desthiobiotin	Photometer readings	2,500 micrograms desthiobiotin per liter and varying amounts of biotin	Photometer readings
0.0	4.5	0.0	4.5	0 0	19.0	0.0	5.0
0.015625	15 0	0 015625	11 0	7.181	22.0	0.0125	3.0
0.03125	22.0	0 03125	6.0	15.625	20.0	0.025	3.0
0.0625	34 0	0 0625	7 5	31.25	19.0	0 05	6.0
0 125	53.0	0.125	7 5	62.5	18 0	0.1	8.0
0.25	64.0	0.25	7.5	125 0	14.0	0 2	22 0
				250 0	11.0	0 4	56.0
				500.0	13.0	0.8	60.0
				1000.0	9.0	1.6	62.0
				2000.0	5.0		
2,500 0	70 0	2,500.0	4.0	4000 0	4.0		

desthiobiotin was added to the biotin can not be ascribed to the effect of the high concentration of this substance in the medium because the organism made an excellent growth in the presence of 2,500 micrograms of biotin. An examination of the last two columns of Table 1 furnishes more conclusive evidence of the anti-biotin effect of desthiobiotin. While smaller amounts of biotin failed to overcome the blocking effect of desthiobiotin within the time limit of the experiment, larger quantities readily neutralized the anti-biotin effect of this substance. Even after an incubation of 24 hours, 0.4 microgram of biotin per liter effectively overcame the effect of 2,500 micrograms of desthiobiotin.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A RAPID METHOD FOR MAKING PERMANENT MOUNTS OF MOSQUITO LARVAE

MOSQUITO larvae as well as other soft-bodied insects are frequently mounted on glass slides for taxonomic study and permanent safekeeping. There are several common mounting methods, plus numerous variations now being used by mosquito taxonomists. Rather serious disadvantages, however, are encountered in the use of three of the most commonly used techniques.

Canada balsam is an old and excellent mounting medium, but the generally accepted technique of dehydration in alcohols and clearing in xylol frequently results in a collapsed, brittle specimen with many lost and broken hairs. In addition the use of this technique requires a great deal of time, since the clearing process is usually quite lengthy.

Euparal is another resin frequently used, but it is now almost impossible to obtain and if obtainable is quite expensive. To secure best results with the use of this material, specimens should be placed in ethylene glycol mono-ethyl ether (Cellosolve solvent) before being mounted in euparal.

Many workers advocate mounting in an aqueous medium such as Berlese's chloral gum solution or one of its modifications. By the use of this substance specimens may be mounted directly from water after being killed. This is an excellent temporary medium, but it should not be used for permanent mounts because it evaporates badly, hardens very slowly, and even if the cover slip is ringed it will frequently evaporate and ruin the slide. This medium also tends to discolor after a period of a few years.

A technique has been worked out at this laboratory which eliminates many of the above disadvantages and results in a permanent preparation. The procedure is as follows: larvae are killed in hot water and then placed in 70 to 75 per cent. ethyl alcohol for 10 to 15 minutes. This time may be shortened somewhat if the venter is pierced in several places with a minuten nadeln or similar fine pointed needle. The specimen is next placed in 95 per cent. alcohol for 3 to 5 minutes and from there is dropped into absolute alcohol for about 5 seconds. It is then placed in creosote U.S.P. until the specimen has cleared sufficiently. In the case of a very delicate specimen the creosote should be diluted with equal parts of absolute alcohol before being placed in undiluted creosote. The time the specimen should remain in creosote will vary but is generally only a matter of a few minutes. Several larvae may be placed in the creosote at one time and the clearest ones removed first. The specimen is finally placed on a clean glass slide, excess creosote removed, but care should be used not to touch the larva. It is then covered with Canada balsam, oriented, and the cover slip applied. If the tip of the abdomen is severed while in the balsam, the slide should be held for several days to permit the balsam to harden. The cover slip can then be applied. This prevents the severed portion from drifting and makes a more presentable mount.

A wide-mouth medicine dropper or a small curved spatula should be used to transfer the specimens and care should be used to handle them as little as possible.

This procedure is quite rapid, the ingredients are readily available, the specimens do not collapse or harden and lastly the preparation is a permanent one.

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PRESENT AND POST-WAR HEALTH PROBLEMS IN CONNECTION WITH PARASITIC DISEASES[1]

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As a nation without imperialistic aims and with few colonial possessions, we have viewed with considerable nonchalance the tropical disease problems of other countries. Now that we are engaged in an all-out war on many fronts, we are frantically endeavoring to absorb and put into practice knowledge of these exotic diseases. For the moment, most of these problems are military problems, but sooner or later they are apt to become public health problems of direct concern to our civilian population.

Our past military campaigns in tropical areas have been confined to small-scale operations in Cuba, Puerto Rico, the Philippines and briefly in Central America. Now our troops are serving by the thousands in such hotbeds of exotic disease as Africa, India, China and the South Pacific. While every effort is being made by our military authorities to practice effective preventive medicine in these areas, it is inevitable that some of our troops will contract one or more tropical diseases and will return to the United States as infected individuals. Already the homeward trek of these men has begun. The return of military personnel from all these areas will probably constitute a cumulative introduction of tropical disease equaled or exceeded only by such introduction during the slave-trading days. It is well, therefore, to consider some of the possibilities which confront us and to ponder the relationship of these possibilities to civilian health.

Some of the diseases of greatest importance from a military standpoint and possibly from a subsequent civilian standpoint are those caused by protozoan and

[1] Presented before the Section on Epidemiology, Wartime Conference, American Public Health Association, New York, October 12, 1943.

helminth parasites as well as others which are transmitted by various species of insects and other intermediate hosts.

Many of these parasitic diseases are characterized by a relatively long incubation period, by pronounced chronicity, by lack of permanent immunity and by difficulties in diagnosis; there are no successful means of immunizing an individual against them, and for many of them we have no satisfactory treatment. These facts all add to the probability that the parasitic diseases will be the ones most likely to be brought back by returning troops and the ones which may well prove to be of considerable concern from a public health standpoint.

Protozoal Diseases

Malaria. This disease has always been the scourge of armies operating in tropical or sub-tropical countries and we can only expect that the present conflict will offer no exception to this rule. In our brief military excursion in the Spanish-American War, over half of our troops contracted malaria. In World War I our malaria problem was confined to the southern camps and extra-cantonment areas. For the most part our troops were engaged in temperate or cold climates where malaria was not endemic. But now the sons of the veterans of that war are in combat in some of the most highly malarious areas on the globe. Under these circumstances, we may expect a considerable morbidity rate from this disease.

Many infected individuals will return as carriers of the disease and many will go back to their homes in parts of the country which have long been free of the infection. A proper concentration of carriers in areas where there is a suitable concentration of vectors will lead to the establishment of new endemic centers of malaria. Furthermore, there is the probability of the introduction of new strains as well as new species in areas in which all the several species do not at present exist. We already have isolated examples of the potentialities of such occurrences even with the introduction of a limited number of carriers. For instance, Craig[2] has reported the incident of the National Guard company from Connecticut, the members of which contracted *Plasmodium falciparum* infection in southern camps during the Spanish-American War and introduced this species in their home community on their return from the service, a community in which only *P. vivax* had previously been known.

Matheson[3] has cited the Aurora, Ohio, outbreak of 1934 to show the explosive effect of the introduction of a single case in a community, in which a suitable mosquito host was available.

During and following World War I, malaria reappeared in England after a lapse of sixty years. The outbreaks resulted from the introduction of the disease by returning soldiers, mostly by those who had served in the Macedonian campaign.

We may anticipate as a post-war development the probable occurrence of numerous instances of the above-mentioned sort. In the present endemic areas, we may expect introduction of new strains to which even already infected individuals may have little or no resistance. In the many parts of the United States in which anopheline vectors are found outside of the infected zones, it is probable that we shall see localized outbreaks over a period of years.

The situation calls for farsighted planning to meet the eventualities which we are bound to have to face. It is a question whether as a public health measure we should not now be placing even more emphasis on control of anopheline mosquitoes in endemic zones and extending this control work into areas which have long been free of the disease. Also, in some of these latter areas we must know more about the distribution and ecology of vectors.

Amoebiasis. Like malaria this disease is endemic in the United States, where about 10 per cent. of individuals examined in surveys have been found infected. Following the last war, there was some apprehension that soldiers returning from overseas might spread the disease widely over the country. In this connection Boeck and Stiles[4] made a total of 13,043 examinations of 8,029 individuals for intestinal parasites. These persons included overseas veterans, troops stationed in the United States, persons with no military service and persons whose service connection was unknown. The incidence of *Endamoeba histolytica* in overseas soldiers was no higher than that encountered in the other groups.

Kofoid, Kornhauser and Plate[5] found an incidence of *E. histolytica* of 10.8 per cent. in 1,200 overseas soldiers and an incidence of only 3 per cent. in 300 on home service. However, the incidence in the former group was not materially different from that encountered generally in surveys in this country.

As with malaria, however, we are faced with a situation somewhat different from the one that confronted us in the first World War. Some time ago, an eminent medical officer remarked that amoebic dysentery has never been a military problem except in the Philippines during the Spanish-American War and the In-

[2] Charles F. Craig, Publication No. 15, Am. Asn. Adv. Science, Washington. 1941, pp. 131–134.

[3] Robert Matheson, Publication No. 15, Am. Asn. Adv. Science, Washington. 1941, pp. 157–162.

[4] William C. Boeck and Ch. Wardell Stiles, *Hygienic Lab. Bull.* 133, Treasury Dept., Wash., 1923, 198 pp.

[5] Charles A. Kofoid, Sidney I. Kornhauser and J. T. Plate, *Jour. Am. Med. Asn.*, 72: 1721–1724, June 14, 1919.

surrection. This statement is of course true, but the fact must not be overlooked that the Philippine campaign is the only one of any consequence which we had fought in a tropical country. At the present time our troops are in combat in areas in which strains of *E. histolytica* are particularly virulent for those who have not been previously exposed to such strains. Experience in the British Army in North Africa indicates that about one eighth of the hospitalized dysentery cases were due to *E. histolytica*. On the other hand, amoebic dysentery is said[6] to be the prevailing form attacking British troops in India.

The protection of troops against the dysenteries is difficult under combat conditions but the water purification tablets now provided for sterilizing water in canteens are effective under most conditions for the destruction of cysts of *E. histolytica*. The hyperchlorite ampule is still used in the Army Lyster bag but effective cysticidal action is not obtained without, in effect, superchlorination and adequate exposure time. Portable sand filters such as used in advanced zones will probably remove most amoeba cysts from water, provided such units are operated properly. Fly-borne dysentery is not uncommon in troops under certain conditions. Craig[7] has called attention to an epidemic of amoebic dysentery from this source in troops on the Mexican border in 1916, while the widespread outbreak of dysentery in combat divisions taking part in the Marne-Aisne offensive in 1918 was undoubtedly due mostly to the spread of infection by flies, as can be readily attested by the writer.

Consequently, even though the best sort of protection is provided, it is not always possible under combat conditions to make use of available facilities and the dysenteries must be reckoned with in any military campaign. In the case of amoebic dysentery, we may expect the return of a certain number of infected individuals at the end of this war. What effect these carriers will have on our civilian health is problematical, but it is reasonable to assume that their dispersal may well lead to a higher morbidity rate from amoebiasis, and that perhaps new and more virulent strains may be introduced.

Leishmaniasis. Visceral leishmaniasis or kala-azar occurs throughout the Mediterranean littoral, the Near East, India and China. In addition, it has been found in certain parts of South America. Cutaneous leishmaniasis or oriental sore has much the same distribution as kala-azar. Further, we have in parts of South America and in Mexico the mucocutaneous form known commonly as espundia.

Other than a few imported cases, leishmaniasis has not occurred in the United States. Even though the method of transmission of the visceral type of the disease has been definitely established by Swaminath, Shortt and Anderson,[8] as occurring through the bite of sandflies of the genus *Phlebotomus*, we have difficulty in appraising post-war significance of the disease as a public health problem in the United States. It is evident that protection against the vectors of the disease is often impracticable, if not impossible, and that with present diagnostic methods only the most obvious cases are detected. Consequently, we may surmise that infected individuals will return to this country and may serve as reservoirs of infection, possibly over a long period of time. Three species of *Phlebotomus* are described from the United States, and others are known. One species, *P. diabolicus*, which occurs in Texas, is said to be a vicious feeder on man. As a public health measure, it is believed that effort should be made to determine the distribution and ecology of domestic species of *Phlebotomus* and to ascertain the infectibility of *P. diabolicus*. However, it seems probable that this disease will not be one of those of greatest importance which may be introduced by military personnel.

Trypanosomiasis. The possibilities for the establishment of African sleeping sickness seem much more remote than those in the case of other tropical diseases. We do not have in this country species of *Glossina*, a fact which militates against the disease gaining a foothold in the continental United States. We do have other blood-sucking flies, including tabanids and *Stomoxys calcitrans;* the latter has been incriminated as one of the vectors of the disease. However, as African trypanosomiasis has exhibited no tendency to spread extensively in areas where species of *Glossina* do not abound, it would appear that the disease is unlikely to become established in areas where dependence on transmission is limited to other vectors.

The case for the establishment of Chagas' disease is perhaps of more concern. Naturally infected *Triatoma* have been found in various areas in the South, Southwest and California, and reservoir hosts of *Trypanosoma cruzi* are known from some of these areas. No human cases of the disease have been discovered to date in the United States. However, we are sending on various missions numerous individuals to endemic areas in Central and South America and furthermore are importing labor from south of the Rio Grande to work in regions where infected *Triatoma* have been located. It is hoped that fortuitous conditions will not bring about the introduction of human cases and the spread of the disease in this country.

[6] "Amoebic Dysentery as a Water-borne Disease." Editorial, *Indian Med. Gaz.*, 78, 2: 97, February, 1943.

[7] C. F. Craig, *Military Surg.*, 40: 286–302; 423–434, March–April, 1917.

[8] C. S. Swaminath, H. E. Shortt and L. A. P. Anderson, *Indian Jour. Med. Research*, 30, 3: 473–477, July, 1942.

Nematode Parasites

Among the nematode parasites of man, we have endemic in this country the following species: *Ascaris lumbricoides*, *Necator americanus*, *Strongyloides stercoralis*, *Trichuris trichiura*, *Trichinella spiralis* and *Enterobius vermicularis*. While troops on foreign duty may be expected to acquire some of these parasites, the return of such infected individuals will make little difference in the status of these parasites here. On the other hand, some of our military operations are now being carried on in endemic areas of the Old World hookworm, *Ancylostoma duodenale*, and no doubt this infection will be brought back to this country. This species is somewhat more damaging than is *Necator americanus* and is more difficult to remove by anthelmintic treatment. However, the measures applicable to our present hookworm problem will be equally effective in controlling *A. duodenale*.

Filariasis. A nematode infection of more concern from a post-war standpoint is filariasis. This disease was once endemic in the region of Charleston, S. C., Guitéras[9] reporting the first case in 1886. Four years later De Saussure[10] recorded the finding of microfilariae in 22 cases of chyluria in persons born in Charleston. In 1915, Johnson[11] found 77, or 19.3 per cent., of 400 individuals representing routine admissions to Roper Hospital in Charleston to be infected with *Wuchereria bancrofti*. Francis[12] in 1919 examined 37 inmates of a home for the aged in Charleston and reported 13 positive for microfilariae. At the present time, Dr. Kenneth Lynch,[13] of the Medical College of the State of South Carolina, advises that this focus has practically died out.

It is difficult to fathom the circumstances which led to the establishment of filariasis at Charleston and not at other points in the Southern States, since the disease was no doubt introduced elsewhere by slaves from endemic areas in Africa. Perhaps an unusually large number of infected individuals was congregated at Charleston and conditions were extremely favorable for *Culex quinquefasciatus*, which Francis showed to be the intermediate host in that area.

A number of biological factors undoubtedly govern the spread of filariasis in any given locality. These factors include a high rate of infection in the locality, the occurrence in the blood stream of the infected individuals of an optimum number of microfilariae, the presence of a suitable mosquito host in numbers sufficient to provide an optimum rate of infection in this host, the accessibility of infected individuals to such mosquitoes and conditions of temperature and humidity suitable for the development of the microfilariae in the mosquito host.

While nothing is known concerning the infectibility of mosquito hosts in this country, other than that of *Culex quinquefasciatus*, many other suitable vectors undoubtedly occur in the continental United States. If a sufficient number of infected returning troops should be concentrated in areas in which intermediate hosts are prevalent, it is conceivable that filariasis might become reestablished in this country.

The matter of preventing such a circumstance is a difficult one. The period between infection and the appearance of microfilariae in the peripheral circulation is so long that infected individuals might be distributed over the country before the presence of their infection could be established while they were still in military service. Further, not all persons with microfilariae actually develop clinical symptoms, although, conversely, some with marked symptomatology may never show microfilariae.

The problem arises as to what disposition should be made of returning troops infected with *W. bancrofti* or *W. malayi*. Since there is no specific treatment for filariasis, there is no known way of destroying microfilariae in the blood stream, and therefore no method of sterilizing carriers. Furthermore, it would not appear feasible to retain these men in military service under quarantine conditions, since their infection might persist for years. Under these circumstances, a certain number of carriers will no doubt be distributed over the country. The probable number of such carriers is unpredictable. For this and other reasons, it is impossible to hazard a guess as to the opportunities for the reestablishment of the disease here. However, the seriousness of the disease and the potentialities of the situation warrant alertness on the part of public health officials. While awaiting further developments, we can at least secure additional information concerning mosquito vectors in this country and continue the search for a drug which will kill adult worms or one which will destroy microfilariae and sterilize female worms so that individuals carrying such worms will no longer serve as reservoirs of infection. Work on both of these problems has been going on in our laboratory for some time.

Onchocerciasis. This very serious parasitic disease occurs in a broad belt through Central Africa and in the Western Hemisphere in the States of Oaxaca, Chiapas and Guerrero, Mexico, and in certain departments along the Pacific Coast in Guatemala. The known vectors in the latter areas include three species of blackflies of the genus *Simulium*. We have little

9 John Guitéras, *Med. News*, 48, 15: 399–402, April 10, 1886.

10 P. G. De Saussure, *Med. News*, 56, 26: 704–707, June 28, 1890.

11 F. B. Johnson, *Southern Med. Jour.*, 8, 7: 630–634, July 1, 1915.

12 Edward Francis, *Hygienic Lab. Bull.* 117, Treasury Dept., Wash., June, 1919, 36 pp.

13 Kenneth Lynch, personal communication.

to fear from the importation of the disease from Africa, but the situation to the south of us is of more concern.

The projected route of the Pan American highway will take the road through the endemic areas in Mexico and Guatemala. While at the present time, there is some movement of infected individuals from one country to another, particularly the movement of laborers on the coffee fincas, the whole region is a fairly inaccessible one. With the advent of the highway, we may expect the opening up of these previously inaccessible endemic zones with consequent migration of non-infected individuals into the zones and the expanded movement of infected persons out of the zones. Although some of the vectors occur outside of the infected zones, knowledge of their distribution is still very meager; furthermore, information is lacking concerning the infectibility of other species of *Simulium*. The fact that the microfilariae of *Onchocerca volvulus* penetrate the structures of the eye and lead to profound visual disturbances with eventual blindness in many cases makes the disease one of great importance from a public health standpoint. Because of the potentialities of the present situation, the Pan American Sanitary Bureau, under the direction of Dr. Hugh S. Cumming, in cooperation with the Republics of Mexico and Guatemala, is undertaking a coordinated program of laboratory and field studies with the view of developing measures effective for the control of the disease.

So far as our information goes, the known vectors of onchocerciasis do not occur in this country. However, Dyar and Shannon[14] listed 27 species of simuliids from the United States, and it is possible that some of these species might be biologically adapted to serve as intermediate hosts of the parasite. While the disease is still far from our borders, it will pay public health officials to keep a weather eye on the situation to the south of us.

CESTODE PARASITES

We already have in this country several species of tapeworms, including *Taenia saginata, T. solium, Echinococcus granulosus* and *Hymenolepis nana* and *diminuta*. *T. solium* has been something of a problem to British forces in India. Military personnel will no doubt be exposed to *Echinococcus* infection in such heavily infected areas as Iceland, New Zealand, Australia and the Mediterranean littoral. Dogs employed by the armed forces in these areas may acquire the infection and measures should be taken to examine such animals and properly treat infected ones before they are brought back to the United States. However, under the improved sanitation in slaughtering establishments in this country, hydatid disease has shown a steady tendency to decline, and it is not expected that our military campaigns abroad will contribute to the spread of infection here.

TREMATODE PARASITES

Our troops have already been exposed and will be further exposed to various trematode infections endemic in various parts of the world. Among the most serious of these trematode diseases are paragonimiasis, clonorchiasis and schistosomiasis.

Paragonimiasis. The oriental lung fluke, *Paragonimus westermanii*, is not a stranger to the United States, since it has been reported from the pig, dog, mink, muskrat, wildcat, domestic cat and goat on this continent. Strong[15] has stated that at least one case of human infection has been reported in North America. Ameel[16] found the operculate snail, *Pomatiopsis lapidaria* Say, to be the first intermediate host of the fluke in this country, and crayfish of the genus *Cambarus* to be the second intermediate hosts.

Cases of paragonimiasis have already been reported as having occurred in troops in certain areas and it is possible that the infection will be acquired by additional individuals. However, the importation of the fluke would seem to constitute no additional public health hazard. The infection has shown no tendency to spread to man in the United States and is not likely to do so since our people do not customarily consume raw crayfish.

Clonorchiasis. Clonorchis sinensis is distributed in various parts of the Sino-Japanese area. It has been brought into the United States frequently by immigrants from the Orient. In accordance with the Immigration Act of 1917, the Surgeon General of the United States Public Health Service classified clonorchiasis as a dangerous contagious disease, making mandatory the exclusion from admission to the United States of persons carrying this parasite.

During the following years, intensive investigations were carried out in California by Wayson[17] to determine whether there was any possibility of the parasite becoming established in this country. These experiments were entirely negative in so far as infection of domestic species of snails was concerned. Furthermore, epidemiological investigations carried on during the same period failed to disclose any autochthonous cases of clonorchiasis in California. So far as is known, no such cases have turned up since that time,

[14] Harrison G. Dyar and Raymond C. Shannon, *Proc. U. S. Nat. Museum*, 69, Art. 10: 1–54, 1927.

[15] Richard P. Strong, "Stitt's Diagnosis, Prevention and Treatment of Tropical Diseases," 1747 pp. Sixth edition. Philadelphia: The Blakiston Company. 1942.

[16] Donald J. Ameel, *Am. Jour. Hyg.*, 19, 2: 279–317, March, 1934.

[17] N. E. Wayson, *Pub. Health Rpts.*, 42, 51: 3129–3185, December 23, 1927.

although eggs of *Clonorchis* are found occasionally in Orientals around San Francisco and in other parts of the state. In view of the above-mentioned facts, it is hardly conceivable that *Clonorchis* would become established here through the return of infected troops from abroad.

Schistosomiasis. At the present time our military forces are distributed in many endemic areas of schistosomiasis, including those in which *Schistosoma mansoni* and *S. haematobium* are present. Eventually we shall probably be campaigning in areas in which *S. japonicum* is endemic.

While several alleged autochthonous cases of schistosomiasis have been reported from the continental United States, the authenticity of most of these cases is open to serious doubt, and it is believed that they are based on mistaken diagnoses. At least, no case was acquired from domestic snails. In considering the possibilities for introduction into the United States of the three species of human schistosomes, a number of factors must be evaluated. Assuming that active cases occur among returning troops and that all these cases are not diagnosed and treated to the final conclusion in that the individuals will no longer be passing eggs of the parasite, we must consider whether the miracidia escaping from these eggs might reach snails and whether such snails might act as suitable intermediate hosts for the parasites.

Eggs given off into sewage systems would probably hatch, if temperature requirements were adequate, but nothing is known concerning the fate of these schistosome miracidia in sewage. Ordinarily, the miracidia are capable of active movement in water for a period of 16 to 32 hours but die after that time if they have not succeeded in reaching a suitable snail host. If sewage has no deterrent effect on the miracidia, it is conceivable that they might reach the treatment plant. If they were not sedimented out, they might be given off with the effluent and reach susceptible snail hosts, provided such snail hosts were available. It is not believed that chlorination of the effluent as commonly practised would be inimical to the miracidia, although more information is needed on the effect of chlorine on miracidia and cercariae.

Dangers of transmission of schistosomes to suitable snail hosts would be much more acute in rural areas in which feces or urine might be deposited in freshwater streams, ponds or lakes. The range of the human schistosomes lies within tropical and subtropical belts in low-lying areas characterized by slow-moving streams amply provided with vegetation, canals, irrigation ditches, marshes, swamps, freshwater ponds and smaller basins of accumulated rain water, conditions which are favorable for the snail intermediate hosts. Since schistosome parasites do not develop in snails under conditions of low temperature, warm climates provide most favorable conditions. Furthermore, the optimum temperature for hatching of ova lies between 25° and 30° C. All these conditions are present in many of our southern states.

In the presence of suitable intermediate hosts, the personal habits of the population in any given locality govern to a large extent the spread of schistosomiasis. For instance, Bettencourt, Borges and de Seabra[18] reported that at Tavira, Portugal, one of the few endemic areas on the European continent, it is the custom of the women to wash clothes in small ponds in which they also commonly urinate, the temperature of the water being favorable for the development of the snail hosts and for the hatching of the ova. In Puerto Rico, *S. mansoni* is confined mostly to parts of the island where there are slow-moving streams clogged with vegetation or where irrigation plays an important part in sugar cane production. The streams and irrigation canals are used for bathing and laundering, while most of the water for household purposes is obtained from the same sources. In endemic areas of *S. japonicum* in China, promiscuous defecation in canals and rice fields and the use of night soil as fertilizer contribute in an overwhelming manner to the perpetuation of the disease.

In the southern United States, where conditions would be most favorable for the establishment of schistosomiasis, the habits of the people are not comparable to those in most areas in which the disease continues to be an important problem. Probably only in exceptionally localized areas would conditions be optimum and circumstances sufficiently propitious for the propagation of the parasite.

However, there are in the United States 10 genera and 9 subgenera of snails of the family Planorbidae, and 12 of these 19 genera and subgenera occur in the southern states.[19] Some of these forms are related to species which are known to be good intermediate hosts of *S. haematobium* and *S. mansoni*. Other than *Helisoma lentum* reported by Faust and Hoffman[20] to be refractory to infection with *S. mansoni*, no experimental work has been done to determine whether these species of snails are susceptible to infection with these trematodes. Until proved to the contrary, it must be assumed that some of them at least might serve as carriers. Opportunities for the establishment of *S.*

18 A. Bettencourt, I. Borges and A. de Seabra, La température de l'eau et la bilharziose a Tavira (Portugal). *Comp. Rend. Soc. Biol.*, 86, 6: 330–331, Fév. 11, 1922.

19 The writer is indebted to Dr. Paul Bartsch, curator of molluscs and Cenozoic invertebrates, U. S. National Museum, Washington, D. C., for information concerning members of the family Planorbidae in the United States.

20 Ernest Carroll Faust and William A. Hoffman, *Puerto Rico Jour. Pub. Health and Trop. Med.*, 10, 1, 1–97, September, 1934.

mansoni would appear to be far better than those in the case of *S. haematobium*, since the former has become established and has flourished in parts of the New World, whereas the latter, though probably repeatedly introduced in the same areas by the same means, has never been able to maintain itself. Further, planorbid snails in the continental United States are more closely related to those species carrying *S. mansoni* than they are to those carrying *S. haematobium*. In the case of *S. japonicum*, members of the genus *Tironius* in Utah and California might serve as intermediate hosts, although these forms differ somewhat in their biological requirements as compared to known carriers of this species.

To summarize the case for the schistosomes, we may conclude that there is a possibility of their establishment in the continental United States and that this possibility is more pronounced in the case of *S. mansoni*. This conclusion presupposes the occurrence of fortuitous circumstances involving large numbers of returning troops infected with the parasites, the concentration of considerable numbers of infected individuals into given areas, particularly rural areas in the southern states, where conditions would be most favorable for the propagation of the parasites, and the presence of suitable intermediate snail hosts.

Military authorities have already agreed to take such steps as are practical to limit the return of carrier cases to their home communities. In view of the lack of information on small hosts, the National Institute of Health is carrying on experiments to determine whether domestic species of planorbid snails can be infected with the various species of schistosomes. If such species are found, the situation would warrant extensive studies on the ecology and distribution of the incriminated forms.

THE INTRODUCTION OF DISEASE VECTORS

The catastrophic consequences of the introduction of *Anopheles gambiae* into northeastern Brazil are too well known to need reiteration. This circumstance, however, has served to emphasize to a marked degree the potential hazards with which the United States is faced in view of our accelerated world-wide air travel. The establishment of more efficient vectors of malaria in our present extensive endemic areas would be followed by disastrous effects on the welfare and economy of the South and might hinder tremendously our war effort. The introduction of exotic diseases by returning troops will render us even more vulnerable to any vectors which might be able to gain a foothold here. Needless to say, the United States Public Health Service is alert to all the potential possibilities in the situation and in cooperation with our military services is exerting every effort to guard our shores against the introduction of disease transmitting species.

One can not leave this general subject without calling attention to the need for training in tropical medicine on the part of public health workers and practising physicians. Our armed forces have done excellent work in better implementing service physicians through the inauguration of basic courses in tropical diseases. After the war is over many of these men will no doubt return to practise with an adequate background in this field and will be capable of diagnosing and treating cases of exotic disease which will come to them.

Likewise, a commendable effort has been made in providing more and better instruction in tropical medicine in our medical schools. Little has been done, however, in furthering knowledge of tropical diseases among physicians remaining in civil life and among public health workers who may be called upon to assume responsibility for the control of any such diseases which may be introduced as a result of our participation in the war. This latter problem would seem to lie within the sphere of influence of this association and might well serve as a subject for further discussion, planning and accomplishment.

OBITUARY

EDWARD BENNETT MATHEWS

DR. EDWARD BENNETT MATHEWS, emeritus professor of mineralogy and petrography at the Johns Hopkins University, died on February 4, 1944.

Dr. Mathews was born in Portland, Maine, on August 16, 1869. He received the bachelor's degree at Colby College in 1891, and was awarded the honorary degree of doctor of science in 1928 as one of its most distinguished alumni. The fact that his family was engaged in slate quarrying in Maine doubtless influenced his choice of a geological career, and led him to study mineralogy and petrography under George Huntington Williams at the Johns Hopkins University. He was awarded the degree of doctor of philosophy in 1894 and was immediately appointed instructor in mineralogy and petrography upon the untimely death of his eminent teacher. As field assistant in the U. S. Geological Survey from 1891 to 1894, he had served invaluable apprenticeships under another great teacher, C. R. Van Hise, in the Marquette district in Michigan, and under the renowned Whitman Cross and R. A. F. Penrose, Jr., in the Pike's Peak region in Colorado. Before beginning his teaching career, he also spent some time in Germany in the laboratory of another

of the great teachers of that day, Harry Rosenbusch. No more discriminating selection of teachers and geologists under whom to train could have been made. At the Johns Hopkins University, he was promoted to the rank of associate in 1895, to associate professor in 1899 and to professor in 1904. Upon the death of William Bullock Clark in 1917, he became chairman of the department of geology, which position he held until his retirement from active university duties at the age of 70 in 1939. None of his colleagues on the teaching staff served the university in more diverse capacities and with more unselfish devotion. He was especially helpful in planning the transfer of the university from down-town Baltimore to the outlying site at Homewood. No one had a greater store of information concerning persons and events in the history of the university.

Soon after the Maryland Geological Survey was established in 1896, he became assistant state geologist, and in 1917 he succeeded William Bullock Clark as state geologist, a position which he held until compelled to retire on account of ill health in 1943. Outside of his university teaching, the greater part of his geologic activity was devoted to the work of the Maryland Geological Survey. The excellent editorship and workmanship of the publications of that survey are mainly the product of his careful attention and his understanding of the arts of printing and engraving. His wide range of interests in many fields of knowledge was instrumental in giving to the publications of the Maryland Geological Survey an unusually wide scope which covered collateral and related fields beyond the customary limits of strictly geologic work. He was an important contributor to most of the volumes published by the survey from his "Bibliography and Cartography of Maryland in Volume 1, published in 1897, to the "Gazetteer of Maryland," published as Volume 14 in 1941. His contributions to the geology of Maryland covered such subjects as the petrography and structure of the piedmont, the building and ornamental stones, the limestones, the coals, the surface and ground waters, the mineral industries, the clays and the physical features. Keen interest in history, bibliography and cartography is reflected in such works as the "Bibliography and Cartography of Maryland," the "Catalog of Published Bibliographies in Geology," "The Counties of Maryland and their Origin," "Maps and Map Makers of Maryland," the report on the resurvey of the Mason and Dixon Line and the report on the location of the boundary line along the Potomac River between Maryland and Virginia. It was this sort of interest that led him throughout the years of his teaching to accumulate analyses of igneous rocks from all over the world, which culminated in the last years of his career as a Geological Society of America project under which he completed a search of geologic literature to assemble all existing analyses of igneous rocks and arrange them geographically by latitude and longitude and by classes. It is to these same interests in history, bibliography and cartography that the department of geology of the Johns Hopkins University owes its excellent geologic library which is so rich in classical and foreign literature and its large collection of foreign maps. The people of the State of Maryland have benefited from his love of cartography through the many useful maps published by the Maryland Geological Survey. Maryland is perhaps the only state provided with county topographic maps of all its counties. Under his direction, the Survey has also published soil maps of all the counties on the topographic base. In addition geologic maps of nearly all the counties have been published and forestry maps of a number of the counties. Other much-used maps prepared by Dr. Mathews are various types of general maps of the state and two editions of a geological map of the state. He also prepared large-scale maps of the principal cities of the state. Especially useful in building projects and public works are his maps of Baltimore City showing respectively the original shore lines and drainage, the configurations of the underlying rock floor and the amount of overburden covering the underlying rock. One of his fellow state geologists in appraising his work closed with the tribute, "He lived a long and fruitful life and Maryland has many things to thank him for."

Dr. Mathews not only served his adopted state as State Geologist, but in many other capacities. He was director of the Maryland Weather Service from 1917 to 1933, executive officer of the State Board of Forestry from 1917 to 1925, member of the Maryland State Development Commission since 1929, member of the Water Resources Commission from its establishment in 1933 until it was merged in 1941 with the Maryland Geological Survey into the Department of Geology, Mines and Water Resources, of which he became director, and member of the Board of Natural Resources since its establishment in 1941. He was also, since 1914, secretary of the Maryland Historical Society Library.

Outside of Maryland, he served for many years as chairman of the advisory council of the U. S. Board of Surveys and Maps, as chairman of the Division of Geology and Geography of the National Research Council from 1922 to 1925, as vice-president and treasurer of the Sixteenth International Geological Congress, and as treasurer, member of the finance committee and councilor of the Geological Society of America since 1917. He was also president of the American Association of State Geologists from 1921

to 1923 and vice-president from 1918 to 1920, 1924 to 1925, and 1930.

His wide human interests and love of geography made him an eager traveler and student of the classic geologic areas of Europe and other parts of the world, experiences that greatly enriched his knowledge of geologic history, places and persons. This wealth of knowledge and experience he was ever ready to share with friends, colleagues and students, who found him an unending and never-failing source of information.

The stimuli to such a wide range of activities and interests were an innate intellectual curiosity and an unselfish desire to be useful to others, and never an urge to display unusual wisdom or to bring himself into the forefront. He adroitly avoided public and formal exhibition of the versatility and range of his knowledge and experience, but he was always ready and happy to share their fruits unobtrusively and informally in friendly conversation. The character and personality of Dr. Mathews can not be more appropriately described than in the words of a colleague of long association who said, " I have never known him to do an unkind or unfair act" and of another fellow geologist who wrote, "All of us who knew Professor Mathews personally had a real affection for him and we had a deep appreciation of his able and unselfish devotion in his chosen field. We shall greatly miss him."

JOSEPH T. SINGEWALD, JR.

RECENT DEATHS

PROFESSOR WILLIAM EDWARD TOTTINGHAM, associate professor of biochemistry at the University of Wisconsin, died on March 2. He was sixty-two years old.

DR. FREDERIC WILLIAM SCHLUTZ, Richard T. Crane professor of pediatrics and chairman of the department at the University of Chicago, died on March 9 at the age of sixty-three years.

DR. HELEN COPELAND COOMBS, instructor in physiology at Brooklyn College, died on March 4 at the age of fifty-two years.

THE death is announced of Dr. H. F. Newall, F.R.S., from 1909 until his retirement with the title emeritus in 1928 professor of astrophysics at the University of Cambridge.

DR. JOHN WILLIAM HENRY EYRE, emeritus professor of bacteriology at the University of London, died on February 17 in his seventy-fifth year.

SCIENTIFIC EVENTS

CHINESE SCIENTIFIC SOCIETIES

IN an account of the joint annual meeting held last July of scientific societies in China, including the zoological, the botanical, the meteorological, the mathematical and the geographical societies, under the presidency of Dr. Wong Wen-Hao, *Nature* reports that Dr. Joseph Needham, Sir William Dunn reader in biochemistry at the University of Cambridge, England, was elected an honorary member of the Science Society of China, in appreciation of "his distinguished academic work and his service in promoting cooperation between Chinese and Western science, which had been so effectively carried on during the previous six months."

The six societies spent two mornings in communicating original papers dealing with their respective sciences; more than three hundred papers were read. Brief abstracts of these papers will be published shortly in Chinese with additional English titles.

One of the two remaining afternoons was devoted to a discussion on "Science and National Reconstruction," with special reference to the problem of how science is to be promoted in China. Opinions were formulated on the following four points, which were presented to the Chinese Government for immediate adoption.

(1) The government is requested to provide a large fund in the forthcoming national budget for, and only for, the furtherance of scientific research and of the scientific education of the masses.

(2) The personnel and equipment of the leading science institutes, such as those of Academia Sinica, must be materially augmented.

(3) The government must endeavor to establish coöperation between the scientific workers on the one hand and officials in charge of national planning on the other, so that the resulting plans may be more practical and fruitful.

(4) While the government is considering sending a large number of young men of science abroad, it is deemed appropriate that such opportunities should be extended to mature scholars also. Here again, the government is requested not to neglect pure science in favor of applied sciences and technology. There was a discussion on "International Science Cooperation," and an address by Dr. Needham entitled "International Science Cooperation in War and Peace" was read by Dr. H. C. Zen, president of the Science Society of China. A scientific exhibition intended for the general public was arranged.

ADVANCED INSTRUCTION AND RESEARCH IN MECHANICS AT BROWN UNIVERSITY

BROWN UNIVERSITY has issued an announcement of the program of advanced instruction and research in mechanics, covering the period since its inauguration

in June, 1941, through the summer of 1944. To provide instruction for men and women who are urgently needed for basic work in mechanical engineering and allied branches of industry, a faculty eminent in the applications of advanced mathematical theory has been serving for eight terms in this program, which is under the auspices of the U. S. Engineering, Science and Management War Training, with liberal support from the Carnegie Corporation and the Rockefeller Foundation.

A recent compilation has shown that from this program more than sixty students have entered on research in mathematics, physics and engineering for government agencies and that twenty-five are serving similarly in war industries. While it was originally expected that students would remain for three or four years and proceed to the doctorate, in the emergency men have taken up useful research after fifteen months of training beyond the baccalaureate.

In addition to the regular instruction given, activities have included

(1) two conferences, one on Non-Linear Vibrations and the other on Exterior Ballistics; (2) fifty-five special lectures by authorities in related fields; (3) the inauguration of a new journal, the *Quarterly of Applied Mathematics*, (4) the publication of twenty research papers by students and the preparation of as many other confidential reports; (5) the preparation of two advanced treatises for printing and the mimeographing and distributing of eleven others; (6) research at Brown University for various government agencies connected with the war.

The Advisory Committee consists of Dr. Thornton C. Fry, mathematical research director, Bell Telephone Laboratories; Marshall H. Stone, professor of mathematics, Harvard University; Theodore Theodorsen, chief of the physical research division of the National Advisory Committee for Aeronautics, Langley Field. The Board of Editors of the *Quarterly of Applied Mathematics* consists of H. L. Dryden, J. M. Lessells, T. C. Fry, W. Prager, J. L. Synge, Th. v. Kármán, I. S. Sokolnikoff; it is assisted by an equally eminent international Board of Collaborators.

The progress made by America in the physical sciences and in the practical aspects of engineering since the turn of the century almost outruns the imagination. But, as was pointed out by Thornton C. Fry in the 1940 report to the National Resources Planning Board, there are some sectors in which we have lagged. We have not kept pace with mathematics fundamental to the development of new industries, such as aircraft manufacture; other countries have ranged dangerously ahead of us. In order that the nation forge ahead in war or in peace, there is need for a more intensive cultivation of the theoretical aspects of some branches of mechanical and electrical engineering. The deficiency is in part due to the paucity of university courses for the graduate training of industrial mathematicians. In part also it is due to a fundamental attitude of the American public which is suspicious of theory. The nation has relied on practical and experimental methods for solving problems; we see this in government as well as in engineering. In a democracy this attitude is attended with grave dangers, for it does not have within itself the seed for its own correction. Some extraordinary means must from time to time be found to bring the necessities of the case home to those with influence in making policies.

These were some of the considerations which occasioned the inauguration at Brown University of the program a few months before war came to America. For the twelve weeks Summer Session of 1944, beginning on June 12, a series of ten courses has been scheduled. On the faculty for the summer are S. Bergman, L. Bers, W. Feller, D. L. Holl, W. Hurewicz, R. K. Luneberg, W. Prager, J. D. Tamarkin and one other still to be chosen. In addition there will be a series of special lectures. No tuition fees are charged; small stipends to cover living expenses are available for some specially qualified persons. A prerequisite is an undergraduate major in mathematics, physics or engineering performed with distinction. The number of participants will be limited to seventy-five. Inquiries may be directed to the Dean of the Graduate School, Brown University, Providence 12, R. I.

R. G. D. RICHARDSON

SCIENTIFIC INSTRUMENTS NEEDED

REQUESTS for instruments urgently needed for essential war work have been received by the Committee on Location of New and Rare Instruments. Any one having any of the following instruments, willing to sell, rent, lend or give them for necessary work, will perform a service by informing D. H. Killeffer, Chairman, 60 East 42nd St., New York 17, N. Y.

Weston Ammeter #622 (0–100 ma)
Weston Ammeter #280 (0–50)
Surface Tension Balance
Precision Cathetometer 32″ Range .003″ error
Babinet Compensator (Soleil)
High Speed Impulse Counter (Cenco #73506 or #73511)
Amsler #4 Integrator
Gas Interferometer (Zeiss or Hilger) (several)
G. E. or Esterline Angus Recording Milliammeter Spring Drive 0–5 ma 6″12″/min speed
Beckman Industrial Model M or Coleman Model 3A pH meter
Weston Microammeter
#643 100 scale div. Res 385 ohms.
#741 100 scale div. Res. 1110 ohms.

Potentiometer—L & N 8660
Potentiometers (type K or other) (several)
(Moderately high or quite high sensitivity)
Campbell Shackelton Shielded A.C. Ratio Box
(Equivalent to L & N A.C. Ratio Box 1553)
Abbe Refractometer (several)
Spectrotelephotometer (Cenco-Sherd)
Quartz Spectrograph
Strobotacs (Genl Radio 631-B)
Stroboscopic equipment
Western Electric Electrometer Tube D-96475
Tinius-Olson Stiffness Testing Machine. Cat. #932
G. E. X-ray Diffraction Unit
Recording Oscillograph (Minimum Sensitivity) (several channels capable of recording one hour at one inch per second. Suitable for aircraft operation.)

A WESTINGHOUSE RESEARCH GRANT TO PURDUE UNIVERSITY

G. Stanley Meikle, research director of the Purdue Research Foundation, and A. A. Potter, dean of the Schools of Engineering, announce the establishment at Purdue University of a project for the "intensive training of graduate students in exploring the field of heat transfer for data upon which many of the practical developments of the future depend." The project was made possible by a grant of $75,000 from the Westinghouse Electric and Manufacturing Company. Dr. George A. Hawkins, professor of mechanical engineering at Purdue University, who has been appointed Westinghouse research professor in heat transfer, will conduct a five-year program for training and research.

Dr. Max Jakob, of the Illinois Institute of Technology, will cooperate with Dr. Hawkins in the capacity of non-resident research professor. Research associates to be known as fellows will be appointed. For their experiments they will have access to the heat transfer laboratory of the School of Mechanical and Aeronautical Engineering. Facilities will be provided also in other departments of the university.

According to the official statement, Director Meikle stressed the importance of advanced student training and research in this field. He described the undertaking as "contributing to the liberalization of the mechanic arts in response to the demand for enlightenment relative to industrial development. It is believed that education and industry are logical participants in the aggressive and balanced development of four major concerns which confront the executives and scholars of a university. These are the conservation of knowledge and ideas; the interpretation of knowledge and ideas; the search for truth, and the training of students who will continue to practice its teachings and carry on its work in the everyday contacts with life's problems."

M. W. Smith, vice-president of the Westinghouse Electric and Manufacturing Company in charge of engineering, said:

> The Westinghouse grant is the latest step in the company's broad educational program which, in cooperation with the nation's universities and colleges, encourages scientific education and research. Annually, the company awards scholarships and fellowships and contributes to the support of research and special educational activities in the belief that knowledge thus gained helps all industry.

NOMINATIONS FOR OFFICERS OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

The national nominating committee of the American Institute of Electrical Engineers, consisting of members from various parts of the country, has nominated the following official ticket of candidates for the offices becoming vacant on August 1, 1944:

For *President:* C. A. Powel, manager of the Headquarters Engineering Departments of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

For *Vice-presidents:*

(North Eastern District)—R. T. Henry, assistant chief electrical engineer, engineering department, Buffalo, Niagara and Eastern Power Corporation.

(New York City District)—J. F. Fairman, assistant vice-president, Consolidated Edison Company of New York.

(Great Lakes District)—M. S. Coover, professor and head of department of electrical engineering, Iowa State College.

(South West District)—R. W. Warner, professor and head of department of electrical engineering, University of Texas.

(North West District)—C. B. Carpenter, assistant chief engineer, Oregon Area, Pacific Telephone and Telegraph Co., Portland.

For *Directors:*

P. L. Alger, staff assistant to vice-president in charge of engineering, General Electric Co., Schenectady.

M. J. McHenry, director of sales promotion, Hydro-Electric Power Commission of Ontario, Toronto.

D. A. Quarles, director of transmission development, Bell Telephone Laboratories, New York.

For *National Treasurer:* W. I. Slichter, professor emeritus of electrical engineering, Columbia University.

These official candidates, together with any independent nominees that may be proposed later, will be voted upon by the membership at the coming election this spring.

H. H. Henline,
National Secretary

SCIENTIFIC NOTES AND NEWS

A DINNER in honor of the eighty-fifth birthday of Dr. William F. Durand, emeritus professor of mechanical engineering at Stanford University, was given by his friends on March 4 in Washington. He was presented with the "W. F. Durand Anniversary Volume" which contains papers selected from those he had already presented before societies in the fields of aeronautics, mechanical engineering, naval architecture and marine engineering.

GLEN DAVID BAGLEY, head of the research division of experimental engineering of the Union Carbide and Carbon Corporation, has been awarded the Jacob F. Schoellkopf Medal for 1944 by the Western New York Section of the American Chemical Society, in recognition of "outstanding and highly significant work, particularly in the fields of the commercialization of very active metals." He is the fourteenth recipient of the medal.

PRESENTATION of the William H. Nichols Medal of the New York Section of the American Chemical Society for 1944 was made on March 10 to Dr. Carl S. Marvel, professor of organic chemistry at the University of Illinois, president-elect of the society. The medal was awarded in recognition of "outstanding organic chemical contributions to the structure of polymers."

THE three hundred and twenty-fifth meeting on March 16 of the Washington Academy of Sciences was devoted to the presentation of its awards for scientific achievement for 1943 as follows: For the *Engineering Sciences,* to Lloyd V. Berkner, physicist of the Department of Terrestrial Magnetism of the Carnegie Institution, Commander, U.S.N.R., in recognition of his distinguished service in research on the ionosphere and wave propagation; for the *Biological Sciences,* to Jason R. Swallen, associate botanist of the Bureau of Plant Industry, Office of the Coordinator of Inter-American Affairs, in recognition of his distinguished service in agrostology, and for the *Physical Sciences* to Dr. Lawrence A. Wood, chief of the rubber section of the National Bureau of Standards, in recognition of his distinguished service in the investigation of rubber and other high polymers.

LIEUTENANT COLONEL NORMAN I. ADAMS, associate professor of physics at Yale University, received on March 9 from the War Department the award of the Legion of Merit. The presentation was made at a ceremony which took place at the university. The citation reads: "Colonel Adams displayed initiative, imagination and high technical proficiency in solving diverse and difficult problems under his jurisdiction, and in a very superior manner conducted research and development in the broad field of physics which resulted in the rapid completion of equipment for the Field Artillery, Army Air Forces and Signal Corps."

DR. HATTIE ALEXANDER, associate professor of pediatrics at Columbia University, is the recipient of the $500 prize given annually under the auspices of the American Academy of Pediatrics by Mead Johnson and Company for "outstanding scientific contributions to pediatrics in the United States." The award was made "in recognition of her work on the treatment of hemophilus influenzae meningitis."

THE Council of the British Institution of Naval Architects has awarded the premium of the institution for the year 1943 to Dr. J. F. C. Conn for his paper entitled "Marine Propeller Blade Deflection."

DR. HARRY R. RICARDO, consulting engineer, has been elected president of the British Institution of Mechanical Engineers.

THE officers of the American Microscopical Society elected for the year 1944 are: *President,* C. E. Allen, University of Wisconsin; *First Vice-president,* W. A. Hilton, Pomona College; *Second Vice-president,* A. H. Wiebe, Tennessee Valley Authority; *Secretary,* J. E. Ackert, Kansas State College; *Treasurer,* A. M. Chickering, Albion College; *Elective Member of Executive Committee,* L. L. Woodruff, Yale University; *Members on the Council of the American Association for the Advancement of Science,* J. E. Ackert and A. M. Chickering.

DR. RAYMOND C. OSBURN, from 1917 to 1942 professor of zoology and entomology and head of the department at the Ohio State University, and Dr. W. W. Charters, professor of education and director of educational research, have retired with the title emeritus.

DR. J. ALLEN SCOTT, senior statistician in the division of vital statistics of the U. S. Bureau of the Census, previously associated with the Rockefeller Foundation in Egypt, has been appointed associate professor of preventive medicine in the field of statistics and epidemiology at the School of Medicine at Galveston of the University of Texas.

DR. DUANE ROLLER, formerly professor of physics at Hunter College, New York, and since 1941 a chief technical aid to the Armor and Ordnance Division of the National Defense Research Committee, has joined the faculty of Wabash College as head of the department of physics. Associate Professor Joseph D. Elder, of the department of physics of Lynchburg College, Virginia, also has become a member of the department.

THE American Public Health Association announces the appointment of Professor C.-E. A. Winslow, Anna M. R. Lauder professor of public health at Yale University, as editor of *The American Journal of Public Health* to succeed Dr. Harry Stoll Mustard, professor of public health practice at the College of Physicians and Surgeons of Columbia University and director of the DeLamar Institute of Public Health.

DR. WILLARD C. RAPPLEYE, dean of the College of Physicians and Surgeons of Columbia University, has been reelected chairman of the Research Council of the Department of Health, New York City. Other officers reelected are Dr. Edward M. Bernecker, commissioner of hospitals, *vice-chairman;* Dr. Alfred E. Cohn, of the Rockefeller Institute for Medical Research, *treasurer,* and Dr. Walter G. Lough, president of the medical board of Goldwater Hospital, *secretary.*

CLYDE E. WILLIAMS, director of the Battelle Memorial Institute at Columbus, Ohio, has been engaged as a technical consultant by the Association of American Railroads. His headquarters will be in Chicago.

DR. MARVIN R. THOMPSON, director of the Warner Institute for Therapeutic Research, vice-president of William R. Warner and Company, Inc., of New York and St. Louis, manufacturers of pharmaceutical products, has been appointed president of the company. Previously he had been pharmacologist and later consultant pharmacologist of the U. S. Food and Drug Administration, associate professor of pharmacology at George Washington University and professor of pharmacology at the University of Maryland.

OWING to a misplacement of lines, under "Scientific Events," on page 139, in the issue of SCIENCE for February 18, it was not made clear that H. C. Diehl, principal chemist and chief of the commodity processing division of the Western Regional Research Laboratory of the U. S. Department of Agriculture, and not Dr. Samuel C. Prescott, had been appointed director of the Refrigeration Research Foundation with headquarters at Berkeley, Calif. In addition to his post as director Mr. Diehl will also serve as secretary for general and scientific business.

IT is reported in *Nature* that Dr. E. F. Armstrong has been appointed chairman of a commission appointed by the Conference of Allied Ministers of Education to report on the problems involved in the supply of scientific equipment to the occupied countries when they have been freed.

THE British Medical Research Council has established a unit for research in human nutrition as part of its staff organization, and has appointed Dr. B. S. Platt as director. Temporary accommodation has been provided at the National Hospital for Nervous Diseases, London. Some part of the investigations undertaken by the unit will be directed towards nutrition problems in the tropics. Dr. Platt will continue the work, for which he joined the staff of the council in 1938, of coordinating a program of nutritional investigations in the colonies.

DR. WILLIAM J. ROBBINS, director of the New York Botanical Garden, addressed the Alpha Lambda Chapter of Beta Beta Beta at Hofstra College on March 3. His address was entitled "What Plants Mean to the World."

HAROLD A. SWANSON, manager of the Patent Department of the National Oil Products Company, Harrison, N. J., spoke on "Patents and the Chemist" at a dinner meeting on March 17 of the New York Chapter of the American Institute of Chemists.

THE American Museum of Natural History has completed reorganization of its exhibition hall of Mexican and Central American Archeology and the new and modernized exhibits were opened to the public on February 26. A private preview of the hall was held on the evening of February 25. It was attended by representatives of Mexico and Central American countries and by trustees and friends of the museum. His Excellency, Dr. Francisco Castillo Najera, the Mexican Ambassador, Dr. Archibald MacLeish, Librarian of Congress, and Dr. Harry L. Shapiro, chairman of the department of anthropology, were the principal speakers on the program. A. Perry Osborn, acting president of the museum, presided, and the address of welcome was made by Dr. Albert E. Parr, director of the museum. Cooperating with the museum on this occasion was the coordinator of Inter-American Affairs and the Pan American Society of the United States.

A BUILDING for the new Medical College of the University of Alabama will be erected at Birmingham. A million dollars for land, buildings and equipment have been appropriated and in addition the sum of $368,750 for the fiscal years ending on September 30, 1944, and on September 30, 1945.

THE School of Medicine of Louisiana State University has received a special appropriation of $36,000 from the Board of Supervisors for the expansion of its library. These funds will be used for purchasing sets of periodicals.

THE Rockefeller Foundation has made an appropriation of $7,500 as a contribution to be used under the direction of Professor F. F. Nord in connection with his researches in enzyme chemistry at Fordham University.

A GRANT of $4,000 from Wallace and Tiernan Company, New York City, to pay for the cost of research

on the sterilization of swimming pools, has been made to the Michigan State College at East Lansing.

PLANS have now been completed whereby the American Society for Metals will provide an annual fund of $1,000 for the support of research in the field of corrosion. The American Coordinating Committee on Corrosion has been designated to receive and approve applications for grants from this fund. A subcommittee on research has been appointed under the chairmanship of Dr. R. M. Burns, assistant chemical director of the Bell Telephone Laboratories, New York, N. Y. Other members are T. S. Fuller, of the General Electric Company; Dr. F. W. Adams, of the Pittsburgh Plate Glass Company, and Dr. H. L. Maxwell, of the E. I. du Pont de Nemours Experiment Station. The committee will select such research projects as appear worthy of support, will approve the qualifications of applicants for grants-in-aid from the research fund, and will certify to the American Society for Metals the names of successful applicants. The grants-in-aid will vary from $250 to $1,000.

THE Williams and Wilkins Company has announced the establishment of the Passano Foundation "for scientific and educational purposes, particularly to provide for scientific research and to publish the results of scientific research and to make awards for meritorious achievements in scientific research." By the terms of the charter the board of directors may inaugurate the establishment of "an annual award not to exceed $5,000 for an outstanding contribution by an American citizen to the advancement of medical science made within the year." The directors include Dr. Emil Novak, associate in gynecology at the Johns Hopkins University Medical School, and Dr. George Corner, director of the Embryological Laboratory of the Carnegie Institution of Washington. E. B. Passano is chairman of the board and Robert S. Gill is president.

IT is planned to establish at the University of Oxford a center for research and postgraduate study for the prevention of blindness and the better treatment of diseases of the eye. The Ophthalmological Research Endowment Committee, of which Sir William Goodenough is chairman, plans to raise £250,000 for the purpose. So far about £26,000 towards the founding of a department of ophthalmology has been collected.

DISCUSSION

PURIFICATION AND ANTIBACTERIAL ACTIVITY OF FUMIGACIN AND CLAVACIN

THE rapid progress that is being made at the present time in the study of antibiotic substances produced by microorganisms can best be illustrated by an examination of the results of recent investigations of two mold products, fumigacin and clavacin. In the eighteen months that have elapsed since the first announcement[1] of the production of these two substances by two groups of fungi, *Aspergillus fumigatus* and *Aspergillus clavatus*, respectively, they have been crystallized and their chemical nature determined. Moreover, each has been described under different names, and one has been found to be produced by several different groups of fungi. In order to avoid further confusion in the characterization of these two chemical compounds, a brief summary of the results thus far obtained is justified.

Fumigacin was originally described[2] as a substance produced by a number of strains of *A. fumigatus*, as containing a small amount of nitrogen, as active largely against gram-positive bacteria and as characterized by appreciable toxicity to animals. Menzel, Wintersteiner and Hoogerheide[3] demonstrated that fumigacin prepared from *A. fumigatus* by the method of Waksman, Horning and Spencer[2] contained 20 per cent. gliotoxin, a substance high in nitrogen and in sulfur[4] and appreciably toxic to animals; when the gliotoxin fraction was removed, the purified fumigacin was found[4,5] to retain its original antibacterial activity, was free from nitrogen, and possessed only a limited toxicity to animals. Unaware of these findings, a group of British workers[6] isolated the same substance from a strain of *A. fumigatus* and described it as helvolic acid. This preparation proved to be identical with the purified fumigacin in chemical composition, in antibacterial activity and *in vivo* activity. Helvolic acid must, therefore, be considered as identical with fumigacin.

Clavacin was originally prepared[2] only in crude form. It was reported to be active against a variety of bacteria found among both the gram-positive and the gram-negative groups, and was highly toxic when

[1] S. A. Waksman, E. Horning and E. L. Spencer, SCIENCE, 96: 202–203, 1942.

[2] S. A. Waksman, E. Horning and E. L. Spencer, *Jour. Bact.*, 45: 233–248.

[3] A. E. O. Menzel, O. Wintersteiner and J. C. Hoogerheide, *Jour. Biol. Chem.* In press.

[4] J. R. Johnson, W. F. Bruce and J. D. Dutcher, *Jour. Amer. Chem. Soc.*, 65: 2005–2009, 1943.

[5] S. A. Waksman and W. B. Geiger, *Jour. Bact.* In press.

[6] E. Chain, H. W. Florey, M. A. Jennings and T. I. Williams, *Brit. Jour. Exp. Path.*, 24: 108–119, 1943.

injected into the animal body, 3.5 mg being lethal per kilogram of body weight.[7] Recently, two contributions appeared dealing with the isolation and crystallization of clavacin from two kinds of fungi, *Penicillium patulum*[8] and *A. clavatus*;[9] both preparations proved to be identical chemically. A comparison of the respective antibacterial spectra, as announced for the crude clavacin[10] and for patulin[8] (the name given to the substance isolated from *P. patulum*), and as found for crystalline clavacin[11] further established the fact that the two substances are identical. The crystalline clavacin was found to be less toxic to animals than crude clavacin,[11] its activity being in this respect, as well, identical with that reported for patulin.[8]

As this note was being written, an article appeared[12] dealing with the identity not only of clavacin and patulin, but also of claviformin, a substance produced by *P. claviforme*;[13] the authors,[12] believing that they were the first to crystallize clavacin, proposed a new name for this substance, namely, clavatin. It may be of interest to record here that clavacin, as first announced,[1] possessed quantitatively all the antibacterial properties of the crystalline preparation, thus pointing to the fact that it was in a nearly pure, even though non-crystalline, state. The isolation of claviformin was announced simultaneously with that of clavacin. Furthermore, the claviformin preparation contained a small amount of sulfur, and the wrong chemical formula was suggested for it ($C_9H_8O_5$). Comparative data for the various preparations are brought out in Table 1.

TABLE 1

Name of preparation	When announced	Empirical formula	Melting point °C	Antibacterial activities	
				E. coli units	*S. aureus* units
Clavacin, non-crystalline	Aug 20, 1942[1]	......	......	165,000–230,000[10]	100,000–200,000[10]
Claviformin	Aug. 1942[13]	$C_7H_6O_4$	110	80,000	160,000
Patulin	1943[8]	$C_7H_6O_4$	111	33,000–50,000	33,000 50,000
Clavacin, crystalline	Jan 7, 1944[9]	$C_7H_6O_4$	109-110	200,000–250,000[11]	200,000[11]
Clavatin	Dec 25, 1943[12]	$C_7H_6O_4$	109.5–110.5	.....	64,000–128,000

These results definitely indicate that the five preparations are identical in their chemical nature and antibacterial activities (slight quantitative differences in activity may be due to the use of different strains of test organisms). Whatever may be the final decision concerning the proper designation of this substance, the fact remains that three different organisms, *A. clavatus*, *P. claviforme* and *P. patulum*, produce the same antibiotic substance.

It is thus important to record here that considerable confusion has arisen from the fact that various microorganisms are capable of producing the same type of antibiotic substance. This has already been demonstrated for the following: citrinin is formed by *P. citrinum* and *A. candidus*; penicillic acid, by *P. puberulum* and *P. cyclopium*; penicillin, by *P. notatum*, *P. chrysogenum* and *A. flavus*; gliotoxin, by *Trichoderma*, *Gliocladium* and *A. fumigatus*; spinulosin, by *P. spinulosum* and *A. fumigatus*; and clavacin by *P. claviforme*, *A. clavatus* and *P. patulum*.

For the sake of completeness, it should also be mentioned that much confusion in the study of antibiotic substances has arisen from the fact that many organisms are capable of producing more than one type of substance. It is sufficient to call attention to the confusion that has arisen from the designation of the second antibacterial factor produced by *P. notatum*, namely, the glucose-oxidase, which has been designated as *E. coli* factor, penatin, notatin and penicillin B, and which has often been confused with the true penicillin. *A. fumigatus*, however, apparently tops the list, since it has the capacity of forming four different antibacterial compounds, spinulosin, fumigatin, fumigacin and gliotoxin, the first two of which are closely related.

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[7] H. Robinson, Some toxicological, bacteriological and pharmacological properties of antimicrobial agents produced by soil microorganisms. Thesis. Rutgers Univ., 1943.

[8] H. Raistrick, J. H. Birkinshaw, S. E. Michael, A. Bracken, W. E. Gye and W. A. Hopkins, *Lancet*, 245: 625–635, 1943.

[9] I. R. Hooper, H. W. Anderson, P. Skell and H. E Carter, SCIENCE, 99: 16, 1944.

[10] S. A. Waksman and A. Schatz, *Proc. Nat. Acad. Sci.*, 29: 74–79, 1943.

[11] Unpublished data.

[12] F. Bergel, A. L. Morrison, A. R. Moss, R. Klein, H. Rinderknecht and J. L. Ward, *Nature*, 152: 750, 1943.

[13] E. Chain, H. W. Florey and M. A. Jennings, *Brit. Jour. Exp. Path.*, 23: 202–205, 1942; see also recent note in *Lancet*, 246: 112–114, 1944.

A LAST WORD ON "STARRING"

I HAVE read with interest Dr. F. C. Whitmore's remarks in SCIENCE for November 26, 1943, on "starring," but was somewhat surprised to note how far he has strayed from the original meaning of this distin-

guishing mark for certain men of science. According to Dr. J. McKeen Cattell in the preface of the first edition of "American Men of Science" (January, 1906), "the star means that the subject of the biographical sketch is probably among the leading thousand students of science of the United States." This meaning has been followed in succeeding editions of "American Men of Science" and it is specifically stated in the caption of the last voting list, which reads: "Chemists nominated for inclusion among the one hundred and seventy-five leading chemists in the United States."

Dr. Whitmore, however, interprets starring somewhat differently. He speaks of the large loss of leading chemists by some institutions which has caused them "to encourage the younger members of the chemistry staff and to add to that staff young men of promise" and then refers later to "a chance of the accidental omission of the name of a deserving young scientist by the group which makes the preliminary nominations." Now this emphasis placed by Dr. Whitmore on youth is lacking in the caption of the voting list which does not read "one hundred and seventy-five deserving young chemists of promise" but "one hundred and seventy-five leading chemists." Youth, of course, must be served, but it is a far leap from the status of a "young chemist of promise" to that of a "leading chemist." The young chemists of promise may eventually become leading chemists, and it is hoped that they will, but until they are so recognized their names should not be placed on a ballot intended solely for leading chemists. The inclusion of their names on such a list means the exclusion of the names of older, better known chemists with greater records of accomplishments.

We should feel indebted, however, to Dr. Whitmore for having disclosed what seems to have been the guiding motive of some institutions in making up the list of their nominees. The insertion of the names of young men by an institution on a voting list along with the names of older scientists involves a lowering of the average production rating of its entire group of nominees; the young men, however promising, haven't had the time to produce. An easily determined, although not wholly satisfactory, index of productivity is the number of papers published during a certain period of time. It is open to several objections but is free from bias and vastly better than basing one's judgment on mere acquaintance, or hearsay evidence, or solicitation, or preference for the members of a particular college. It is useful as a rough, convenient measuring stick and was so applied to the nominees of the two institutions with the highest number of candidates on the last voting list, as summarized in my paper in SCIENCE for September 24, 1943.

For the institution with 8 nominees the following number of papers, of which a candidate was author or co-author, according to the last Decennial Index of Chemical Abstracts, was found to be, respectively: 82, 25, 24, 21, 21, 12, 9, 3—a total of 197, or an average of 24.6 per man. Five of the nominees had published more than 20 papers, which speaks well for the chemical productivity of this institution. The average age of these five candidates, according to "American Men of Science," was 48 years; the average age of the nominees who had published less than 20 papers was 38 years. This institution seems to have placed a little greater stress on men of productivity. The other institution with 7 nominees on the voting list showed the following records. Number of papers published per individual for the same decennial period: 59, 14, 12, 3, 2, 2, 1—a total of 93, or an average of 13.3 per man. The age of the nominee with 59 papers was 53 years; the average age of the remaining candidates who had published less than 20 papers was 36 years. This institution, in making up its list, seems to have placed stress almost entirely on young men of promise. A number of institutions, represented on the voting list with only a few nominees, seem to have concentrated almost wholly on men of productivity. One university with only 3 candidates had a total productivity of 112 papers, or an average of 37 papers per man. As to how far older chemists of high productivity may possibly be exposed to "a chance of the accidental omission," referred to by Dr. Whitmore, the single example is cited of a prominent institution that has 8 excellent "unstarred" chemists of an average age of 55 years who for the same decennial period published 279 papers or an average of 35 per man. Not one of their names appears on the last list of chemists nominated for "starring."

The future of the practice of "starring" men of science would seem, therefore, to depend on whether candidates are to be nominated on the basis of accomplishment, or on that of youthful promise. If it is to be a designation for accomplishment the list of nominees to be voted upon should be made up accordingly, with a short statement as to age, past experience, honors, attainments, etc., of each candidate. That only two institutions on the last voting list of chemists should be represented by over 18 per cent. of the nominees indicates a very unsatisfactory distribution. The conditions responsible for this unsatisfactory distribution seem to be (1) a growing tendency on the part of certain strong, influential institutions to exceed their quota of candidates by nominating so-called "young men of promise" and (2) the failure of many directors of research in other institutions to sponsor better known chemists of established scientific attainment.

C. A. BROWNE

SCIENTIFIC BOOKS

X-RAY CRYSTALLOGRAPHY

X-Ray Crystallography. An Introduction to the Investigation of Crystals by their Diffraction of Monochromatic X-Radiation. By M. J. BUERGER, associate professor of mineralogy and crystallography, Massachusetts Institute of Technology. xxii + 531 pp. New York: John Wiley and Sons, 1942. $6.50.

THIS useful book deals with that part of x-ray structural analysis employed to determine for a crystalline substance "the crystal symmetry in the larger sense: the crystal class, the space lattice (its type and dimensions), and the space-group." The material covered is further limited to those techniques which utilize single crystals and monochromatic radiation, thus excluding consideration of the powder and Laue procedures; in point of fact the discussion of the rotating and oscillating crystal techniques, while quite adequate, is incidental to the treatment of the various moving film methods. Although requiring somewhat more complicated equipment, the moving film methods offer the great advantage of registering three film coordinates for each diffraction spot. The author shows how to exploit this and other advantages fully and with great simplicity, particularly for the most important "equi-inclination" Weissenberg method.

Essential theory, design and operation of apparatus, simple indexing procedures, connections with group theory, precision determination of lattice constants—these and related topics are treated in great detail. A discussion of the systematic application of plane-group theory to the interpretation of the observed diffraction symmetries of equi-inclination Weissenberg photographs resulting in a very direct determination of the probable space-group(s) rounds out a definitive treatment of the Weissenberg method. The limitations of any x-ray method for determining the space group of a crystal are properly emphasized, and detailed tables makes clear the specific ambiguities wherever they arise. The inclusion of a brief discussion of auxiliary methods, *e.g.*, observation of face development, tests for piezo and pyro electricity, etc., which frequently aid in the selection of the probable space-group, would have provided additional guidance in this connection.

The book is addressed primarily to those more or less actively engaged in some phase of crystal structure analysis and should be particularly useful to the beginner in the field. Only a quite modest background in physics and mathematics is required, the development is extremely detailed, and the text is replete with excellent diagrams and illustrations. In the opinion of this reviewer and of two of his students who have used the book extensively, the treatment would have gained ultimately in clarity while permitting of some condensation through the more consistent use of elementary vector analysis. A separate section or appendix, giving in one place a complete explanation of the systematic notation now used for space-groups also would have been desirable.

The comprehensive account given of the Weissenberg equi-inclination method should encourage the wider use of this powerful technique. An equally detailed companion volume to continue with the more interesting and more difficult problem of determining atomic positions within the unit of structure would be welcomed, especially by the student beginning the study of structural analysis.

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EXPLOSIVE CHEMISTRY

Laboratory Manual of Explosive Chemistry. By ALLEN L. OLSEN and JOHN W. GREENE. vi + 106 pages. 13.8 × 21.1 cms. New York: John Wiley and Sons, Inc. London: Chapman and Hall, Limited. 1943. Price $1.75.

THE material in this manual has been used by the authors in presenting short courses in explosives under the Engineering Science and Management War Training Program. The book is primarily a compilation of the usual chemical analyses and specifications of the common military explosives. As the authors have stated, the details of testing and the included specifications are those which have been outlined by the War Department in their most recent printing of "Military Explosives, Technical Manual, TM 9-2900." Olsen and Greene have, however, included more detail and have emphasized precautions in manipulations.

The contents have been divided into five chapters: I. Safety. II. Propellants, Raw Materials. III. Propellants, Nitrocellulose and Smokeless Powder. IV. High Explosives. V. Primers, Igniters and Initiators. Following the last chapter is an appendix on "Sampling."

The chapter on "Safety" is valuable but does not place sufficient emphasis on the individual characteristics of explosives and the frequent unpredictability of their behavior. It should be demonstrated to the student that there are three types or classes of explosives and that there is a wide range of behavior in each class. These facts can be made clear by a few simple experiments with such explosives as black powder, smokeless powder, lead azide, nitroglycerin and guncotton.

The text is very limited, for it has nothing to offer the chemist or physicist who is engaged in research on explosives or to any one who is interested in testing the explosive properties of these substances. Although the authors obviously did not have such read-

ers in mind, this expectation would not arise if the title were a less comprehensive one, such as "Chemical Analysis and Specifications of Military Explosives."

The text will be a handy reference for persons engaged in control analysis since the directions are clear and concise. It is, perhaps, a small point, but the reviewer hopes that the phrase "explosive chemistry" occurring in the title of the text does not find common usage. Many students and chemists have had experiences in "explosive chemistry" without having been interested at such times in the "Chemistry of Explosives."

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SPECIAL ARTICLES

GUAYULE PLANTS WITH LOW CHROMOSOME NUMBERS

SUCH Russian workers as Dianova *et al.*[1] and Botschanszeva[2] reported that *Parthenium argentatum* (guayule) usually has 72 chromosomes (diploid number). Recently we learned from G. Ledyard Stebbins, Jr. (personal communication), that he has found among plants from commercial strains from Salinas the following chromosome numbers: $2n = 54$, 58 (± 2), 72, 74 and 108–112.

In the fall of 1942, Dr. LeRoy Powers collected seeds of guayule in Mexico and Powers and Walter T. Federer in the Trans-Pecos region of Texas. Many of the plants grown from seeds collected in Durango, Mexico, have thinner leaves than those of the 72-chromosome types. In general they may be characterized as vigorous growers, early and prolific seed producers. Many are light green in color, probably due to a chlorophyll deficiency. On both light and dark green plants the trichomes are shorter than on plants of higher chromosome number. Eleven of these plants were examined cytologically and were found to have from 36 to 39 chromosomes. They are from four different locations within the mountainous area on the border of which are the towns of Santa Librada, Patinta, Maravillas, Capilla and S. Francisco, southwest of the city of Mapimí.

Chromosome counts were made mostly at the diakinesis and prophase II stages in pollen-mother-cells because chromosomes are better separated then than at metaphase II, although the latter was used whenever possible. Flower heads were prefixed in a mixture of seven parts absolute alcohol and one part glacial acetic acid. Dissected disc florets were stained with synthetic orcein in 45 per cent. acetic acid. Mature pollen grains were stained with aniline blue-lactophenol. Five hundred from each plant were counted to determine the amount of aborted grains. The diameter inside the exine of 100 grains from each plant was measured with an ocular micrometer.

These plants are considered to be diploids because at diakinesis all eleven plants have 18 pairs of chromosomes. A few pollen-mother-cells in one plant seemed to show an association of four chromosomes and in another plant possibly as many as three such associations. Whether these are due to reciprocal translocations or are an indication of polyploidy is not known at present. In addition, most of these plants showed one, two or three very small chromosomes. These very small chromosomes are to be seen also in plants from Texas and in commercial strains. A study of somatic chromosomes seen occasionally in dividing tapetal cell nuclei has led to the supposition that these small chromosomes are the equivalent of the short arm of one of the types of medium-sized chromosomes. Lagging chromosomes were seen in one plant. Chromatid bridges were observed in three other plants.

In addition to these eleven plants, the pollen of another from the same area was studied carefully. Although the amount of aborted pollen varied considerably among the different plants (from 3 per cent. to 60 per cent.) the diameter inside the exine of filled grains was quite uniform. An average of these twelve plants showed that 5 per cent. measured 12.4 μ, 33 per cent. 14 μ, 58 per cent. 15.5 μ and 3 per cent. 17.1 μ. The grains are not absolutely spherical. For comparison, an average of five plants which belong to the 72-chromosome class showed that one per cent. measured 15.5 μ, 9 per cent. 17.1 μ, 57 per cent. 18.6 μ, 27 per cent. 20.2 μ, 5 per cent. 21.7 μ, and one per cent. consisted of giant grains. In addition, a limited examination was made of the pollen of 28 more plants from the same area. Since all showed the same-sized pollen grains as the 12 mentioned above, they also are considered to be diploids having 36 or about 36 chromosomes.

A cytological study also has been made of two dwarf plants from seeds collected in Texas. Both were found recently by Dr. Powers among plants grown from seed collected on the O2 Ranch. They are dwarfed, with thin, crinkled leaves that have a tendency to cup. One had a height of 5 cm and spread of 6 cm compared with nine normal plants in the same collection and culture which averaged 14 cm and 14 cm respectively. The second had a height of 7 cm and spread of 7 cm, while eight normals in the same collection and culture averaged 13 cm and 15 cm, respectively. How-

[1] V. I. Dianova, A. A. Sosnovetz and N. A. Steschina, *Beih. Bot. Centralb.*, 53: 294, 1935.

[2] S. Botschanszeva, *Acta Univ. Asiae Mediae, Tashkent, Ser. VIII b, Botanica:* fasc. 15, 1938.

ever, they have the same coloring as the rest of the plants in the culture which have 72 (±1 or 2) chromosomes. The anthers were shrunken, transparent and practically empty. Among immature anthers a few gigantic, misshapen pollen grains were found, these apparently consisting of the entire pollen-mother-cells which had developed an exine, and a few compound small grains, the results of only partial cytokinesis. A dividing tapetal cell nucleus of one of these plants showed 38 chromosomes, including one very small one. The other plant had 36 to 38 chromosomes, as indicated by an examination of the diakinesis and metaphase I stages in pollen-mother-cells. In both plants only a few bivalents were found at metaphase I. The univalents, of greater length than when associated as bivalents, were scattered somewhat along the axis of the spindle. The walls of the pollen-mother-cells were extremely thin. It was concluded that although these two dwarf plants also belong to the 36-chromosome class, they are to be considered as haploids of the 72-chromosome population in which they occurred.

The contrast in morphological appearance and in chromosome behavior between the 36-chromosome plants from Durango and those from Texas emphasizes the fact that more than mere chromosome number is needed for an understanding of the appearance and breeding behavior of guayule plants. Judging by the plants obtained from seed collected in Mexico and in Texas, the 36-chromosome Durango plants seem to be the only type in certain locations and to comprise an appreciable part of the population in other locations where 54-chromosome plants also occur; whereas the 36-chromosome plants from the O2 Ranch in Texas are among the off-types found in a population that seems to consist almost entirely of 72 (±1 or 2) chromosome plants.

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FATAL ENCEPHALITIS IN MAN DUE TO THE VENEZUELAN VIRUS OF EQUINE ENCEPHALOMYELITIS IN TRINIDAD

By the early part of October, 1943, approximately seventy cases of fatal encephalitis had occurred among the horses and mules in Trinidad, British West Indies. The epizootic was tentatively diagnosed as equine encephalomyelitis by the local authorities from the clinical symptoms presented. Accordingly, the sector veterinarian of Trinidad, Major R. T. Gilyard, Army of the United States, sent representative portions of brain tissue from two donkeys, two horses and a mule that had died of the disease to the laboratories of the Army Veterinary School, Medical Department Professional Service Schools, Army Medical Center, Washington, D. C., for diagnosis. The first material, that from a donkey, was received on October 11, 1943. Later he submitted brain tissue from a human case of encephalitis that had died on August 22, 1943. Brain tissue was shipped in buffered glycerine by airmail express and arrived within two days after shipment.

A ten per cent. suspension of brain tissue was prepared from each of the six cases and injected intracerebrally in 0.1 cc amounts into two guinea pigs, and in 0.03 cc amounts into three Swiss mice. The inoculated animals presented typical symptoms of equine encephalomyelitis in periods varying from three to eight days. They were sacrificed while in a moribund condition and their brains removed for further study.

The laboratory animals inoculated with brain suspensions from the donkeys, horses and mule became prostrate within 96 hours. Those inoculated with the human brain tissue became prostrate by the eighth day. This may be explained by the fact that brain tissue from the animals was received within two to three days after autopsy, whereas the human brain tissue had been held in Trinidad for six weeks in buffered glycerine solution under refrigeration before it was shipped to this laboratory.

Laboratory animals infected with virus from each of the six cases were sacrificed when prostrate, their brains removed, and when found to be bacteriologically sterile were prepared for typing of the viruses.

These six strains of virus when isolated were injected intracerebrally into each of three groups of guinea pigs; one group immunized against Western type virus, the second group against the Eastern type and a third group of normal animals. The groups of Western immune and normal guinea pigs died within 96 hours and in the Eastern immune group the death period extended to the fifth or sixth day, a condition that has previously been noted in Eastern type immune animals injected with the Venezuelan equine encephalomyelitis virus.[1] The results on the animal brains were reported to Major Gilyard on October 21, 1943.

By this time we had obtained Venezuelan equine encephalomyelitis vaccine and immunized a group of guinea pigs. Two weeks after completion of vaccination this group exhibited no illness following intracerebral injections of the six isolated viruses, indicating that the virus was the Venezuelan type in all six instances. Guinea pigs immunized against the Eastern and Western viruses and normal animals served as controls.

[1] C. E. Beck and R. W. G. Wyckoff, Science, 88, 530, 1938.

Of the three immunologically different strains of equine encephalomyelitis viruses known to be present in the Western Hemisphere, fatal human cases due to the Eastern type virus were established by Fothergill, Dingle, Faber and Connerly[2] in 1938, and somewhat later in the same year Howitt[3] reported the isolation of the Western type virus from a fatal human case.

Although Venezuelan type equine encephalomyelitis in man may have been suspected,[4] there is record of only two cases having been reported. These were of a very mild type and occurred in the United States in laboratory personnel working with the virus.[5]

The present report records the first instance in which the Venezuelan strain of equine encephalomyelitis virus has been proven to occur naturally in man, producing a fatal infection. Further, it establishes the fact that all three strains of equine encephalomyelitis viruses known to be present in the Western Hemisphere are capable of producing a fatal encephalitis in man.

From available information, this is the first outbreak of equine encephalomyelitis in Trinidad, B. W. I., and immunity tests have proven it to have been caused by the Venezuelan strain of virus.[6]

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

MULTIPLE ELECTRODE HOLDER FOR THE HORSLEY-CLARKE INSTRUMENT

FOR electroencephalographic study of the interior of the animal brain an apparatus to hold several electrodes in place simultaneously is essential. Specifications were submitted to Mr. R. Kittel, Chicago, the maker of the Horsley-Clarke instrument, who designed and constructed a satisfactory attachment. Three bakelite rectangles, each 46 × 57 mm and about 1 mm thick, were drilled with holes to fit No. 11 bead needles coated with insulating varnish. The holes are in 41 rows 1 mm apart, and each row has 31 holes 1 mm apart. The three plates were then fastened together with screws at the corners, using metal sleeves on the screws to hold the plates 5 mm apart. The complete assembly is equivalent to a block 13.5 mm thick. It is mounted on a brass frame attached by screws at four points to the upper lateral bars of the Horsley-Clarke instrument. When in place, needles in the holes are vertical with respect to the brain. An adjustment on the frame allows the multiple holder to be moved laterally, so that the center row of holes can be placed exactly over the midline.

Insulated bead needles inserted through the holes in the holder into the brain keep their positions without fastening. The depth of a needle point in the brain is controlled by measuring the length of needle exposed above the upper surface of the multiple holder. Since this upper surface is 46 mm above the interaural plane, and a needle is 53 mm in length, the needle point is at the interaural plane if 7 mm of needle remains exposed. Connections to the amplifier and stimulating device are made by inserting fine copper wires through the eyes of the needles. As many needles can be used at one time as there are points on the selector switches.

The holes in the multiple carrier now in use will do for 26-gauge hypodermic needle tubing if it is desired to use shielded electrodes. It was not necessary to order the drilling of so many holes. The attachment would be just as useful, and less expensive, if it had about 800 holes, properly placed, instead of 1,271.

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[2] L. D. Fothergill, J. H. Dingle, S. Faber and M. L. Connerly, *New England Jour. Med.*, September 22, 1938.
[3] B. Howitt, SCIENCE, 88, 455, 1938.
[4] Mentioned in: A. S. Lleras and L. Figueroa, Biol. Inst. Nac. Hig. Semper Martinez, 1942, 8, 3.
[5] J. Casals, E. C. Curren and L. Thomas, *Jour. Exp. Med.*, 77, 521, 1943.
[6] Since this manuscript was submitted an additional eight non-fatal cases of infection acquired in laboratory workers were reported by E. H. Lennette and H. Koprowski, *Jour. Am. Med. Asn.*, 123: 1088, 1943.

BOOKS RECEIVED

GLASSER, OTTO and OTHERS. *Medical Physics.* Illustrated. Pp. xlvi + 1744. The Year Book Publishers, Inc. $18.00.

JOHNSON, WILLIAM H. and LOUIS V. NEWKIRK. *Modern Drafting.* Illustrated. Pp. vii + 197. Macmillan Company. $2.50.

NEWMARK, MAXIM. *Illustrated Technical Dictionary.* Pp. 352. The Philosophical Library. $5.00.

POPE, FRANCIS and ARTHUR S. OTIS. *The Airplane Power Plant.* Illustrated. Pp. iii + 188. World Book Company.

REEVE, WILLIAM DAVID. *Essential Mathematics.* Illustrated. Pp. iv + 282. The Odyssey Press.

Rose's Foundations of Nutrition. Fourth edition. Revised by GRACE MACLEOD and CLARA MAE TAYLOR. Illustrated. Pp. xi + 594. Macmillan Company. $3.75.

SHUTE, WILLIAM GEORGE, WILLIAM WRIGHT SHIRK, GEORGE FORBES PORTER and COURTENAY HEMENWAY. *An Introduction to Navigation and Nautical Astronomy.* Illustrated. Pp. xiv + 457. Macmillan Company. $4.50.

SCIENCE

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

ANNUAL MEETING AT CLEVELAND, OHIO, SEPTEMBER 11–16, 1944

By Dr. F. R. MOULTON
PERMANENT SECRETARY

After cancelling meetings for two years on request of the Office of Defense Transportation because of transportation difficulties, the association will hold its annual meeting for 1944 in Cleveland, Ohio, from September 11 to September 16, inclusive. All affiliated and associated societies have been invited to participate in the meeting so far as it may be possible for them to do so. If transportation conditions are favorable, the meeting will be well attended; if there are serious traffic congestions in September, it will be streamlined to the extent that may be necessary.

September was chosen as the time for the meeting, first, because the holiday seasons must be avoided, and, second, because for at least some colleges and universities this is an open period between sessions. In particular, it is the week at Case School of Applied Science between the departure of one group of trainees and the arrival of another group, and it is the week between the summer and autumn sessions at Western Reserve University. Since Case School of Applied Science will provide several meeting rooms and Western Reserve University a large number, this consideration is very important. After the close of the war annual meetings of the association will be held again at the Christmas holiday season or perhaps at some other time that may be more advantageous. Such questions will be open for consideration after the Cleveland meeting.

Cleveland was chosen for the place of meeting because it is about the only city in the country that now

can provide 40 to 50 rooms for simultaneous sessions and accommodations for a large convention. Dr. William E. Wickenden, president of Case School of Applied Science, will be chairman of the General Committee for the meeting. Western Reserve University will make its facilities available to the association and its affiliated societies. The Scientific Exhibition and the general registration will be in the arena of the Cleveland Auditorium.

Two conferences of the secretaries of the sections and affiliated societies were held for the purpose of discussing general policies to be followed in organizing programs for meetings of the association and its affiliated societies. Secretaries of sections and of affiliated societies who live in the Middle West met in Chicago on February 13; those living in the East met in New York on February 20. The following named secretaries and officers of the association attended the Chicago conference:

W. A. Albrecht (University of Missouri), secretary of the section on agriculture.

C. C. Allison (The Ohio State University), secretary of the American Phytopathological Society.

A. J. Carlson (The University of Chicago), president of the American Association for the Advancement of Science.

L. V. Domm (The University of Chicago), secretary of the American Society of Zoologists.

William A. Dreyer (University of Cincinnati), secretary of the Ecological Society of America.

Neil E. Gordon (Wayne University), secretary of the section on chemistry.

Glenn L. Jenkins (Purdue University), chairman of the subsection on pharmacy.

A. C. Kinsey (Indiana University), secretary of the American Society of Naturalists.

Paul C. Kitchin (The Ohio State University), secretary of the subsection on dentistry.

W. M. Krogman (The University of Chicago), secretary of the section on anthropology.

D. H. Leavens (The University of Chicago), representative of the Econometric Society.

George W. Martin (State University of Iowa), secretary of the section on botanical sciences.

C. E. Mickel (University of Minnesota), president of the Entomological Society of America.

F. R. Moulton (Smithsonian Institution Building, Washington), permanent secretary of the association.

Orlando Park (Northwestern University), president of the Ecological Society of America.

H. H. Remmers (Purdue University), secretary of the section on education.

H. H. Ross (University of Illinois), secretary of the Entomological Society of America.

L. H. Snyder (The Ohio State University), secretary of the Genetics Society of America.

E. C. Stakman (University of Minnesota), member of the Executive Committee.

L. H. Tiffany (Northwestern University), representative of the Limnological Society of America.

Sam Woodley (Smithsonian Institution Building, Washington), assistant secretary of the association.

C. C. Wylie (State University of Iowa), secretary of the section on astronomy.

The following named secretaries and officers of the association attended the New York conference:

Paul R. Burkholder (Yale University), secretary of the Botanical Society of America.

O. W. Caldwell (Boyce Thompson Institute for Plant Research), general secretary of the association.

A. J. Carlson (The University of Chicago), president of the association.

Frank D. Carvin (Newark College of Engineering), secretary of the section on engineering.

E. N. Cory (University of Maryland), secretary of the American Association of Economic Entomologists.

J. T. Culbertson (Columbia University), secretary of the American Society of Parasitologists.

L. K. Frank (New York Academy of Medicine), guest.

E. P. Hutchinson (U. S. Department of Justice, Philadelphia), secretary of the section on social and economic sciences.

E. S. Johnston (Smithsonian Institution Building, Washington), secretary of the American Society of Plant Physiologists.

J. R. Kline (University of Pennsylvania), secretary of the American Mathematical Society.

Burton E. Livingston (Riderwood, Maryland), chairman of the Executive Committee.

F. R. Moulton (Smithsonian Institution Building, Washington), permanent secretary of the association.

Gardner Murphy (College of the City of New York), guest.

R. J. Seeger (U. S. Navy Department, Washington), secretary of the section on historical and philological sciences.

G. A. Stetson (Engineering Societies Building, New York City), editor of the American Society of Mechanical Engineers.

A. C. Swinnerton (Signal Corps, U. S. War Department), secretary of the section on geology and geography.

H. B. Tukey (New York State College Experiment Station, Geneva), secretary of the American Society for Horticultural Science.

Sam Woodley (Smithsonian Institution Building), assistant secretary of the association.

These conferences were not concerned primarily with the numerous administrative details that must be given attention in preparation for a great meeting of many sections and societies. Instead, they were almost entirely devoted to such fundamental questions as the relations and obligations of science to the future of civilization, the purposes of scientific meetings, the interrelations among various sciences and between the natural and the social sciences, the value both of re-

ports of special researches and of syntheses of broad fields of science, and the importance of placing the methods and spirit of science, as well as its results, before the general public. Such discussions lead first to attitudes of mind rather than to specific actions, yet a few resolutions were passed by both conferences. The principal one passed by the Chicago conference was the following:

Resolved, that this conference recommend that the fundamental nature of science, its relations and obligations to society, together with the means of securing public comprehension of the scientific method and attitudes, be considered as subjects to be stressed in the September meeting, both in general sessions and in symposia and, as may seem desirable, in the meetings of the individual sections and societies.

This resolution was approved at the New York conference. As a first step toward putting it into effect, the secretaries of three affiliated societies, Dr. Paul R. Burkholder, secretary of the Botanical Society of America, Dr. Earl S. Johnston, secretary of the American Society of Plant Physiologists, and Dr. H. B. Tukey, secretary of the American Society for Horticultural Science, at the close of the meeting promptly went into a huddle to consider what joint programs their societies might advantageously organize. Evidently it will require much cooperative work and experimentation to increase the number and improve the quality of programs of the type that was proposed. In recognition of this fact the Chicago conference passed a supplementary resolution to the effect that the "sections and societies continually study ways and means of more effective organization and presentation of their programs at annual meetings."

In the course of the discussions it was suggested that it might be advantageous for more of the larger societies to hold regional meetings for the presentation of short reports on current research, and to reserve for the annual meetings the presentation of mature work and extensive symposia. As a matter of fact, a number of societies, such as the American Mathematical Society, have long held what are in effect regional meetings. But in this complex world in which the sciences are more and more interrelated, it would be in the long run a serious error for specialists in any field to isolate themselves from specialists in other fields. Cross-fertilization in science is as important as in biology and inbreeding is as likely to lead to sterility.

Another question that will be considered in this transition period is the date of the annual meeting of the association and its affiliated and associated societies. The Christmas holiday period has advantages which are well known, and also serious disadvantages. A meeting of several days at that season of the year is almost certain to conflict with family parties and reunions. Another serious matter is that Christmas varies from year to year throughout the entire week. Furthermore, the Christmas season is always a period of heavy railroad travel and the weather is often unfavorable. Perhaps in the future the latter part of November or early December would be more satisfactory. Of course, there is always the problem for university men of interrupting their lectures. But this disadvantage might be largely relieved by starting the meetings on Thursday or Friday and continuing until the following Tuesday or Wednesday. The British Association for the Advancement of Science usually times its meetings in this way, and with conspicuous success. Since few university lectures are scheduled for Saturdays and not all are given on Mondays, a meeting continuing over the week-end would not seriously disrupt university schedules. There would be advantages, too, for scientists in government bureaus and industrial laboratories.

However, attention must now be centered on the Cleveland meeting in September. Some inconveniences must be expected but, with our entire economic order disrupted by the war, scientists will be as inventive in overcoming difficulties as are farmers and manufacturers. The problem of "reconversion" for most scientists will be relatively simple.

The New York conference listed a number of subjects suitable for programs at the Cleveland meeting, such as "science and the post-war world, with particular emphasis upon rehabilitation, education and research; science and world peace; a national policy for science; agencies which support science; science and government; science and civilization; science and research; science and education; science and rehabilitation; can science exist half free and half controlled?"

Evidently not all these important problems can be discussed at one meeting, but such questions should be considered at meetings of the association because scientists are members of society and strongly influence our social order. Such subjects should be examined because reflection on them will broaden the vision of scientists and aid them to guide the development of science more wisely. They should be considered in open forums in order to place before the general public the high purposes of science, something of its methods, and its supreme importance for the advancement of civilization. This last reason for such discussions is not the least, for ultimately the progress of science will rest upon society as a whole.

THE EFFECTIVENESS OF OVARIAN AND HYPOPHYSIAL GRAFTS IN THE PRODUCTION OF MAMMARY CARCINOMA IN MICE[1]

By Dr. LEO LOEB, Dr. H. T. BLUMENTHAL and MARIAN MOSKOP KIRTZ
LABORATORY OF RESEARCH PATHOLOGY, WASHINGTON UNIVERSITY SCHOOL OF MEDICINE, ST. LOUIS, MO.

Two methods are available for the determination of the effects of internal secretions: (1) A diminution or elimination of the function of the organ in which certain hormones are produced should lead to a quantitatively corresponding diminution in the structural or functional effects of these hormones. (2) An increase in the quantity of the hormones should be followed by an increase in their effects. By a quantitatively graded diminution of the time during which the ovaries gave off hormones which stimulate the activities of the mammary gland, it was first shown that there exists a quantitative relation between the origin of mammary carcinoma in mice and the cancerigenic action of ovarian hormones on the mammary gland in mice.[2] This represented also the first demonstration that hormones may cause the development of cancer and that substances normally produced in the body in the usual quantity may be responsible for the initiation of cancer; it was pointed out that presumably also other hormones may have cancerigenic effects in the organs and tissues on which they act specifically and that it appears probable that with the cooperation of hereditary conditions all those internal secretions, which initiate or sustain continuous or periodic growth processes, are factors in the origin of cancer.[3] The hormones interact with genetic-hereditary (constitutional) factors in a quantitative manner approximately in accordance with the equation S (hormonal stimulation) × H (hereditary-genetic factors) = C (Cancer).[2] This equation applies also to other types of cancer, and a similar equation applies even to other biological phenomena. More recently it has been shown by Bittner[4] that in addition to these two factors a substance present in the milk, as well as in certain organs of the mother and transmitted to the sucking child, may play a part in the origin of mammary carcinoma, although not of cancer in general. It seems probable that this factor acts in a way similar to that in which genetic factors act, namely, by determining the degree of responsiveness (sensitization) of the tissues to the stimulation by ovarian hormones.

After the proof had thus been given by means of the first method that endogenous hormones may cause the development of cancer, the attempt was made to supplement this proof by increasing the incidence of mammary cancer and accelerating the time of its appearance by increasing the quantity of ovarian hormones in accordance with the second method. This was first attempted by the transplantation of ovaries from sisters to castrated brothers in as yet incompletely inbred strains of mice. These first attempts failed, probably because an insufficient similarity between the individuality differentials of host and donor of the transplants prevented a satisfactory functioning of the grafts.[5] In subsequent similar experiments in a more closely inbred strain Murray was able to observe the formation of mammary tumors in about 7 per cent. of castrated male mice;[6] and more recently de Jongh and Korteweg[7] obtained positive results in a higher percentage of animals. Development of mammary tumors in male mice was induced also by Lacassagne by means of injections of very large doses of estrogen over long periods of time.[8] Several years ago it could be shown moreover that implantation of anterior lobes of the hypophysis into virgin females of strain A, which had been closely inbred by L. C. Strong, raised the incidence of mammary carcinoma in these mice to approximately 42 per cent. from about 4 per cent. in controls, while in low mammary tumor rate strains merely increased proliferative and secretory processes in the mammary gland could be obtained. However, positive effects of the anterior pituitary grafts were noted only if ovaries were present in the hosts; in ovariectomized females and in males the results were negative.[9]

We now wish to report on new experiments on 427 mice, which had received transplants of ovaries or anterior pituitaries or a combination of both, as well as on the findings in 504 control mice which had not

[1] This investigation was carried out with the aid of a grant from the International Cancer Research Foundation.

[2] A. E. C. Lathrop and Leo Loeb, *Jour. Cancer Res.*, 1: 1, 1916; L. Loeb, *Jour. Med. Res.*, 40: 477, 1919; SCIENCE, 43: 293, 1916; *Am. Jour. Med. Sciences*, 19: 781, 1920; *Jour. Cancer Res.*, 2: 135, 1917; 8: 274, 1924; *Report Internat. Conference on Cancer, London*, p. 84, 1928; C. F. Cori, *Jour. Exp. Med.*, 45: 983, 1927; L. Loeb, *Acta Union Internat. Contre Cancer*, 2: 148, 1937; *Jour. Nat. Cancer Inst.*, 1: 169, 1940.

[3] L. Loeb, SCIENCE, 42: 912, 1915.

[4] J. J. Bittner, SCIENCE, 84: 162, 1936; *Am. Jour. Cancer*, 30: 530, 1937.

[5] L. Loeb, *Jour. Med. Res.*, 40: 477, 1919.

[6] William Murray, *Jour. Cancer Res.*, 12: 8, 1928.

[7] L. E. de Jongh u. R. Korteweg, *Act. Brev. Neerland.*, 5: 126, 1935.

[8] A. Lacassagne, *C. R. Acad. d. Sci.*, 195: 630, 1932.

[9] L. Loeb and Marian Moskop Kirtz, *Am. Jour. Cancer*, 36: 56, 1939.

received transplants of ovaries or lobes of the hypophysis. The organs and grafts were examined microscopically partly by means of serial sections. Usually from two to four anterior pituitaries or ovaries or a combination of both these organs were transplanted into each of the 427 mice. Somewhat more than one half of these experiments were carried out in strain A mice which are most suitable for investigations in transplantation; the remaining mice belonged to the high tumor rate strains C3H and D, to the medium tumor rate strain New Buffalo and to the low tumor rate strains C57, CBA, Old Buffalo and AKA. Some of the earlier experiments are included in this report. It may be stated that in male mice mammary gland carcinoma hardly ever occurs spontaneously in any strain, nor was mammary gland carcinoma observed in the strain A virgin females which served as controls.

Our principal observations and conclusions are as follows: (1) After transplantation of ovaries into castrated male mice the cancer rate and proliferative as well as secretory activities of the mammary gland were greater than after transplantation of these organs into normal female mice. Transplantation of ovaries into normal female mice led to the development of tumors only in strains C3H and D in which the mammary gland is most strongly sensitized to stimulation by hormones; negative results were obtained with our strain A mice which are less strongly sensitized. (2) Transplantation of anterior pituitaries, obtained in the majority of experiments from brothers or sisters, into normal female mice is at least as effective as transplantations of ovaries into castrated male mice; it is much more effective than transplantation of ovaries into normal female mice. (3) Transplantation of a combination of ovaries and anterior pituitaries into normal female mice is as effective as transplantation of anterior pituitaries alone into the same kind of hosts, or it may perhaps be somewhat more effective. These combined transplants were very active in castrated male mice in strain A in which they produced a cancer rate of 92 per cent. (4) In low tumor rate strains these various kinds of grafts, which in high tumor rate strains caused the development of cancer, induced merely an increase in proliferative processes, often associated with secretory activities in the mammary gland. (5) The greatest intensity of cancer development, and as a rule also of preparatory activities of the mammary gland, was obtained only in mice which belonged to the highest weight classes in conformity with our earlier observations.[10] There existed a certain parallelism between the weight of the mice and the effectiveness of these hormones. (6) By means of a single transplantation of glands, which produce mammary gland-stimulating hormones, as marked a development of mammary cancer in castrated male mice may be initiated, without otherwise pathological effects being noticeable, as by injections of very large amounts of estrogen continued over long periods of time. A mammary cancer rate in castrated male mice may thus be obtained which far exceeds the cancer rate of normal virgin female mice. (7) After transplantation of anterior pituitaries into ovariectomized mice, growth response and tumor formation in the mammary gland were either diminished or entirely prevented. Likewise transplantation of ovaries alone or together with pituitaries into normal male mice did not stimulate the growth of the mammary gland nor cause formation of mammary carcinoma. The anterior hypophysis transplants seem to exert their effects on the mammary gland by way of the ovaries which, under the influence of this additional stimulus, in all probability produce larger amounts of estrogenic hormones than they would otherwise do. Ovariectomy has therefore an effect which greatly differs from that of castration in male mice, which latter enhances the cancerigenic action of ovarian transplants. (8) The development of cancer was observed in these experiments as a rule only after the transplants had been active in the host for a period of about from 6 to 7 months to 12 months, so that the age of the mice at the time of examination ranged approximately between 9 and 14 months. If the examination of the organs took place earlier, the proliferative activities in the mammary gland, often coupled with secretory processes, had not as yet progressed to cancer formation; the latter represents the last stage reached after the tissue has passed through the preliminary or preparatory growth processes in which sensitization of growth stimuli may take place. It has been suggested that at the end of this period an autocatalytically propagating growth substance has developed in the cells as the result of the preceding long-continued stimulation, a substance which would thus be directly responsible for the ensuing cancerous growth.[11] The facts established in the present investigation are in harmony with this interpretation. Within the last twenty-five years a number of investigators have carried out experiments concerning the action of ovarian and pituitary hormones on growth and secretion in the mammary gland.[12] While in some respects the results

[10] L. Loeb, V. Suntzeff, H. T. Blumenthal and M. Moskop Kirtz, *Arch. Path.*, 33: 845, 1942.

[11] L. Loeb, SCIENCE, 43: 293, 1916.

[12] C. R. Moore, SCIENCE, 52: 179, 1920; *Jour. Exp. Zool.*, 33: 129, 1921; C. R. Moore and D. Price, *Am. Jour. Anat.*, 50: 13, 1932; A. Lipschütz and collaborators, *Pflüger's Arch.*, 211: 206, 305 and 697, 1926; E. T. Engle, *Proc. Soc. Exp. Biol. and Med.*, 25: 83, 1927–28; 25: 715, 1927–28; G. K. Smelser, *Physiol. Zoology*, 6: 396, 1933; W. U. Gardner, *Endocrinology*, 19: 656, 1935; C. E. Lane, *Am. Jour. Physiol.*, 110: 681, 1935; A. A. Lewis and C.

obtained in these various investigations appear contradictory to one another, on the whole the conclusions of the majority of these investigations agree with our observations concerning the processes taking place during the preliminary growth period. (9) There are two principal conditions which inhibit or prevent the development of mammary cancer by ovarian or anterior pituitary transplants: (a) The genetic constitution of the animals or a deficiency in the amount of available milk factor may cause an insufficient degree of sensitization and responsiveness of the mammary gland tissue to the specific hormones (Strains C57, CBA and Old Buffalo). (b) Lack of a sufficient similarity between the individuality differentials in host and donor of the transplants may prevent the survival and function of the grafts for sufficiently long periods of time (strains AKA and also New Buffalo). As pointed out previously, even long-continued close inbreeding of strains of animals does not seem to lead to a completely homozygous condition, owing probably to mutations which occur in these inbred individuals[13] and this applies also to all the closely inbred strains of mice so far tested by us. (10) It has been shown that not only ovarian hormones but also pituitary hormones may be involved in the development of mammary carcinoma in mice and presumably also in other species, in accordance with the conclusion that all those hormones or other factors which stimulate growth processes in an organ or tissue may thereby also affect the production of cancer.

THE CONTRIBUTION OF JAMES McKEEN CATTELL TO AMERICAN ANTHROPOLOGY

By Dr. CLARK WISSLER

THE AMERICAN MUSEUM OF NATURAL HISTORY

Professor James McKeen Cattell died on January 20, 1944. He was widely known as a psychologist and editor of scientific journals, but his contribution to the development of anthropology in the United States seems to have been forgotten. That he played an important role in the history of anthropological teaching may be suspected when we note that for the academic years 1896–1902 he was head of a department of anthropology and psychology at Columbia University. To most anthropologists of the present generation, this may appear as a surprising statement, so, as an outline of the history of anthropology at Columbia University, we submit the following chronological data:

1891. J. McKeen Cattell appointed professor of psychology at Columbia; previous position in University of Pennsylvania.

1893. Livingston Farrand appointed instructor in psychology at Columbia; began giving a course in anthropology also.

1896. Cattell listed as head of the department of anthropology and psychology; Farrand still giving anthropology courses and Franz Boas listed as lecturer.

1901. Farrand listed as professor of psychology, but continues to give courses in anthropology.

1902. Anthropology listed as a separate department, Boas as head, Farrand as a professor of anthropology. Cattell now head of department of psychology.

The interest of Cattell is clearly indicated; he wished to provide for the teaching of anthropology, encouraged Farrand to give courses, later brought Boas into the picture and at the opportune time saw to it that a separate department of anthropology was created. Boas came to New York in 1895 as assistant curator at the American Museum of Natural History under F. W. Putnam; Cattell added Boas to his staff in 1896. Cattell seems to have been acquainted with Boas at Clark University through the work of the latter on the growth of children. Cattell studied with Galton and Pearson in England, where he acquired a deep and lasting interest in anthropometry, so it is to be expected that Boas would come to his notice when he began to write on anthropometry in 1891. It is plain, however, that Cattell was committed to the promotion of anthropology before Boas came into the New York picture.

At Columbia the writer was assistant in psychology, 1899–1900; university fellow in psychology, 1900–1901; assistant and eventually lecturer in anthropology, 1903–1909. These facts are cited to indicate his personal contact with the situation beginning with 1899.

The writer first saw Cattell at a meeting of the American Association for the Advancement of Science in the summer of 1899 at Columbus, Ohio. He participated in the program of Section H, with other psychologists, demonstrating a few testing instruments. incidentally he made a direct appeal to anthropologists to make measurements on Indians and Negroes to secure comparative data. F. W. Putnam was present, speaking enthusiastically in support of the idea. It was clear that a mutual feeling existed in the minds

W. Turner, *Mo. Agr. Exp. Sta. Research Bull.*, No. 310, 1939; A. A. Lewis, C. W. Turner and E. T. Gomez, *Endocrinology*, 24: 157, 1939; J. P. Mixner and C. W. Turner, *Endocrinology*, 30: 591, 1942.

[13] L. Loeb, H. D. King and H. T. Blumenthal, *Biol. Bull.*, 84: 1, 1943.

of these two aggressive leaders that laboratory psychology and anthropology formed a logical team.

Joseph Jastrow, professor of psychology at the University of Wisconsin, was the first laboratory psychologist to become active in Section H, joining the association and presenting his first formal paper in 1886. He was elected chairman of Section H in 1891, the first psychological chairman. Cattell was the second, elected in 1897 and during the same year presented a paper outlining a plan for the "Study of Eminent Men." Cattell's address as retiring chairman of Section H was strongly in praise of anthropology and its objective character and also insistent upon its integration with psychology. Following Jastrow, psychological papers were presented in Section H with fair regularity. In 1907 the name of Section H was changed to Anthropology and Psychology and alternating chairmen became the rule: in 1919, psychology was given a section of its own.

The interest of laboratory psychologists in anthropology was stimulated by Wundt in Germany, the founder of laboratory psychology, who extended his researches into anthropology; so it is natural that his American students (Hall, Jastrow, Cattell and others) should become enthusiastic promoters of academic anthropology in the United States. Cattell studied with Galton in England, also, and was thus further conditioned to the anthropological bias. William L. Bryan, another student of Wundt, was the writer's teacher in laboratory psychology; he encouraged a course in anthropology at Indiana University by George E. Fellows, a student of Ranke, who regarded anthropology a part of history. (The writer attended this course in 1895.)

Thus it is fair to state that the teaching of anthropology in the United States was, in part at least, promoted by laboratory psychologists of the Wundt and Galton Schools. That Cattell played a conspicuous part in initiating the outstanding national academic department is clear from the foregoing historical data.

In 1896 Daniel G. Brinton of Philadelphia presented a motion in Section H for a "Committee on the Study of the White Race in America." Brinton was the first committee chairman; Cattell, an original member, succeeded Brinton in 1899. In the meantime Cattell received a grant-in-aid from the American Association for the Advancement of Science to devise and construct instruments for making mental and physical measurements as equipment for such a survey. Further, in 1895, Cattell began a series of mental and physical tests on students in Columbia and Barnard Colleges, which ultimately furnished data for the writer's Ph. D. dissertation in 1901.

OBITUARY

FRANK EUGENE LUTZ

In the passing on November 27, 1943, of Frank E. Lutz, chairman and curator of the Department of Insects and Spiders in the American Museum of Natural History in New York City, entomology has lost one of its most important leaders and one who has influenced a host of younger men through his example, his writings and his educational activities. His versatile biological interests are apparent in his published papers. His ideals of education are to be seen in his museum exhibits, his pioneer work on nature trails, and his writings on popular aspects of insect life, including his famous "Field Book of Insects" (1917) and his more recent "A Lot of Insects" (1941). For many years he edited the *Memoirs* and *Bulletin* of the American Museum and these publications still reflect many of his policies.

Frank Lutz was born in Bloomsburg, Pennsylvania, on September 15, 1879. He graduated from Haverford in 1900 and took his master's degree in 1902 and his doctor's degree in 1907 from the University of Chicago under the direction of Dr. C. B. Davenport. His doctoral thesis was entitled "The Variation and Correlations of Certain Taxonomic Characters of *Gryllus*," and Dr. Lutz continued his interests in crickets as well as other aspects of insect biology until his death. As late as 1938 he published sound recordings of cricket calls. His early interest in variation, which included work in Karl Pearson's laboratory in London (1902), led directly to studies in genetics, and he was one of the early students of *Drosophila* genetics. He records in his latest book how he became interested in *Drosophila* while working as research investigator at the Carnegie Institution at Cold Spring Harbor and how he noted a white-eyed form and gave the strain in which it appeared to Dr. T. H. Morgan, who initiated the experiments that have made *Drosophila* a standard laboratory animal and genetics a great biological science. Dr. Lutz was brought to the American Museum for the preparation of exhibits on variation and heredity, was appointed assistant curator in 1909, becoming associate curator in 1917 and curator in 1921. Although he took part in twenty-four expeditions to Central and South America, the West Indies and various parts of the United States, during which he collected great numbers of insects that were subsequently studied by various taxonomic specialists, he rather prided himself upon the fact that he never described a new species. He became especially interested in bees and made numerous

studies on their reaction to ultra-violet patterns, but the recording of new forms he preferred to hand on to others. Under his curatorship, the insect and spider collections of the American Museum became one of the most important in the world, numbering almost two million specimens.

Probably his best known "expedition" was to his own back yard and its immediate surroundings near his suburban home in Ramsey, New Jersey. The record of this "expedition" is contained in "A Lot of Insects" written with his characteristic humor and his ability to open up problems of insect life to the lay student as well as to the professional entomologist.

Dr. Lutz's contributions to ecology are numerous and varied. In addition to the reports on his ingenious and novel experiments on insect sounds and visual reactions, he published papers on insect adaptations, spider webs, non-selective characters, diurnal rhythm, insects of thermal waters, humidity in relation to insect physiology, galls, and caddis-worm case building. In his early years he became skeptical of such remarkable cases of recorded adaptation as mimicry of butterflies and defensive capacity of soldier termites, and this skepticism is again apparent in his most recent book.

In addition to improvising and directing the exhibits of insects at the American Museum, Dr. Lutz became interested in 1925 in the exhibition of living animals and plants by means of labelled nature trails and the success of this form of nature education has spread widely. His work in these fields of interest again exhibits his characteristic originality and ingenuity. He always did his best to give information concerning insects to innumerable visitors to the American Museum, and his "Field Book of Insects" was in reality an attempt to answer the common questions about insects asked by the general public.

Numerous scientific honors were bestowed upon Dr. Lutz during the course of his life. He was a member of the American Society of Zoologists and the American Society of Naturalists, he was starred in the second edition of American Men of Science, he was a fellow of the Entomological Society of America and the New York Academy of Sciences, he received the A. Cressy Morrison Prize of the New York Academy of Sciences in 1923, and he was president of the Entomological Society of America in 1927.

In 1904 he was married to Martha Brobson, who survives him together with four children, Frank B. Lutz, Anna Lutz, Ensign Laura Lutz, of the WAVES, and Mrs. Boyd Schurman. It was a pleasure to be entertained in the Lutz home in the nineteen-twenties when the four children were growing up. Both Dr. and Mrs. Lutz joined in the children's games, and any visitor likewise found himself involved. Dr. Lutz, naturally of a nervous disposition, was endlessly patient with the most trivial questions from the children. A genuinely important bit of insect research would be laid aside while a fourth-grade arithmetic problem was so clarified that I am sure many a public school teacher in Ramsey must have received, at third hand, some echo from the Pearson Laboratory.

The bare outline of some of the achievements of his life fails to convey the essence of Dr. Lutz's colorful personality and geniality. His enjoyment of life may be detected in his books which reflect his interest in the unusual as well as the usual. His rich sense of humor was always present in his personal relations as well as in his writings, whether for a professional or lay reader. Possibly his character was best exhibited in his relations to his non-professional colleagues. He was always interested in the amateur naturalist and enjoyed the company of those who made biological studies a hobby rather than a duty. Those who associated with him for years in the New York Entomological Society meetings will understand these qualities of congenial friendliness which are hard to set forth in words.

His own anecdotes were delightful and I am sure he would not mind having one told about him. I attended a meeting of the New York Entomological Society, I believe in 1920, when a speaker was engaged in giving a rather lengthy description of taxonomic characters of a certain group of insects. Dr. Lutz was sitting in the rear of the room and soon was heard to say "Oh Lord!" quite audibly. The speaker said, "In view of the sounds of protest from Dr. Lutz, I shall try to hurry through these descriptions," whereupon Dr. Lutz rejoined, "Go right ahead! At the next meeting I intend to read a check-list of the bees of North America."

ALFRED E. EMERSON

DEPARTMENT OF ZOOLOGY,
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RECENT DEATHS

DR. LEROY S. PALMER, professor of agricultural biochemistry and chief of the division of the department of agriculture of the University of Minnesota, died on March 8 at the age of fifty-six years.

DR. FRANCIS J. BROGAN, instructor in chemistry at Hunter College, New York City, died on March 13 at the age of forty-four years.

DR. GEORGE HUME SMITH, of Indianapolis, Ind., recently professor of mathematics at Butler University, in the past connected with the departments of botany of the University of Illinois and the University of Missouri, and with *Biological Abstracts*, died on February 7 at the age of forty-seven years.

DR. HENRY ANDREW BUEHLER, geologist and di-

rector of the Missouri State Bureau of Geology and Mines at Rolla, died on March 14 in his sixty-eighth year.

Sir David Prain, from 1905 to 1922 director of the Royal Botanical Gardens at Kew, died on March 17 at the age of eighty-six years.

SCIENTIFIC EVENTS

THE ALABAMA RESEARCH INSTITUTE

The Alabama Research Institute was organized as the result of a year's study by a committee of Alabama citizens appointed in 1940 by the Alabama State Chamber of Commerce. Benjamin Russell, the chairman, submitted the report of the committee to the Chamber of Commerce on October 9, 1941. This report concluded:

> That Alabama could no longer afford to sit idly by and permit its vast variety of materials to remain in their present unutilized and unprofitable condition; but instead that Alabama should through scientific research do that which is necessary to bring these materials into profitable use for the comfort and enrichment of the people of our state, as so many other states in our Union are now doing.
>
> Your committee therefore, after unanimously reaching the conclusion that here in Alabama we should have an organization primarily engaged in research work, has drafted a constitution and by-laws for such an agency and adopted as its name Alabama Research Institute.
>
> Alabama Research Institute, in addition to its regular function as a research organization, will act as a co-ordinating agency in research undertakings, with the University of Alabama, Alabama Polytechnic Institute and other state institutions, and private and corporate organizations in Alabama, covering a broad field as is provided in its constitution. . . .
>
> For the general advancement of our state the Alabama Research Institute needs, and your committee believes will have, the active support of the people of Alabama.

Shortly afterwards the institute was organized as a non-profit corporation.

As now planned, the organization will function in a manner not unlike that of other successful research institutions of similar character, several of which were originally organized and endowed by a few individuals who felt that the field of research should be extended or enlarged. The present approach is on that principle—except that many individuals and business concerns are invited to supply the capital. It is intended that there shall be available within the state a well-equipped laboratory, a comprehensive technical library and scientific personnel for general research purposes.

Initially the institute will be financed almost wholly from subscriptions from business and from individuals. These subscriptions are to be used solely for the purpose of implementing the institute as a going business concern, for the introduction of certain researches on Alabama raw materials, to employ a competent research director and staff, to buy equipment, apparatus and supplies, to obtain and accumulate a technical library, to pay rent for a place for housing the institute and for general overhead and administrative expense. After it has been in operation for a few years, it is hoped that it will be self-sustaining from fees paid by private industry for special research programs and from royalties and profits from patents and discoveries developed by the institute from research in its own behalf.

THE ROCKEFELLER FOUNDATION

A review of the work of the Rockefeller Foundation for 1943 is given in the annual report of Dr. Raymond B. Fosdick, president of the foundation, which has just been issued. During 1943 the appropriations amounted to $7,760,186. The income from investments during the year was $8,079,164. The appropriations were distributed for the most part in six major fields, roughly as follows:

Public health	$2,450,000
Medical sciences	1,529,000
Natural sciences	599,000
Social sciences	1,068,000
Humanities	1,055,000
Program in China	108,000

Of the money appropriated during the year, 69 per cent. was for work in the United States and 31 per cent. for work in other countries.

In discussing a report from its representatives in Rio de Janeiro that gambiae mosquitoes, some of them alive, had been found in planes coming from Accra and Dakar in Africa to Natal and that five live gambiae had been discovered in dwellings near the Natal airport, the report points out that though the situation is now in hand, it poses a problem of larger significance which can not be evaded.

> Around the ports of Africa and deep within the hinterland lie the breeding centers of the gambiae. The safety of the Western Hemisphere, which is now within a few hours' flight across a narrow ocean, can no longer be left to the uncertainties of a flit-gun campaign. Modern airplane travel has made old methods and ideas of quarantine completely obsolete. If the Americas are adequately to be protected, the breeding places of gambiae, wherever in Africa or elsewhere they may be found, must be eradicated. The campaign must be carried to the sources of infestation. It can no longer be defensive; it must be offensive.
>
> But the problem, of course, is far broader than gambiae.

This newly made world which the airplane has tied together has lost its frontiers. Certainly in the field of public health they no longer have significance or meaning. No line can be established anywhere in the world which confines the interest of any one country, because no line can prevent the remote from becoming the immediate danger. Whether it is malaria or yellow fever or typhus or bubonic plague or whatever the disease may be, the nations of the world face these enemies of mankind not as isolated groups behind boundary lines but as members of the human race living suddenly in a frightening propinquity.

Public health can no longer be thought of exclusively in national terms. Whether we like it or not, our technologies now confront us with inescapable demands for a new approach. Some kind of regularized international cooperation is essential. Whatever we may think of the League of Nations, its Health Organization blazed a new trail in the international attack on disease—a trail that must be widened into a firm road. Certainly a service of epidemiological intelligence covering the whole world is an immediate necessity, and many other essential public health activities not only lend themselves to collective approach but can be effectively handled only by that method.

WAR CONFERENCE ON INDUSTRIAL MEDICINE, HYGIENE AND NURSING

THE second War Conference of industrial physicians, hygienists and nurses will be held at the Hotel Jefferson, St. Louis, Mo., from May 8 to 14. The participating organizations are the American Association of Industrial Physicians and Surgeons, the American Industrial Hygiene Association, the National Conference of Governmental Industrial Hygienists and the American Association of Industrial Nurses.

Subjects to be presented include welding, in relation to clinical aspects and control of hazards; noise, as to medical phases and means of prevention; better health in small plants; the industrial physician's opportunity to advance medical knowledge; maladjustment and job environment; women in industry, and panel discussions on "Who Can Work?," etc. Two clinics, one surgical, at Barnes Hospital, and the other medical, at Desloge Hospital, will be held during the meeting.

The hazards to health presented by the new synthetic rubber industry, radium, solvents and the toxicology of TNT will be considered; also the possibilities of an excessive silica dust hazard from the quartz crystal industry, which has recently sprung up in many areas of the country; techniques of air sampling in specific reference to the reducing of oil mists and lead fumes, the latter encountered in soldering operations where the hazard is increasing with lack of adequate supplies of tin; and the danger of exposure to cadmium, which is known to be more poisonous than lead and which is responsible for a number of cases of poisoning.

The industrial nurses will consider postwar planning for nurses and medical services in industry.

Reservations at the Hotel Jefferson can be obtained by writing promptly to John Reinhardt, chairman of the "War Conference" Housing Bureau, Syndicate Trust Building, St. Louis, Mo.

THE CLEVELAND MEETING OF THE AGRICULTURAL AND FOOD DIVISION OF THE AMERICAN CHEMICAL SOCIETY

RESEARCH in the problems of food during the war will be reported to the Agricultural and Food Division of the American Chemical Society at the one hundred and seventh meeting of the society to be held in Cleveland from April 3 to 7.

Papers dealing with practically every aspect of food chemistry will be contributed by members of the laboratories of universities, industries and federal services. On Thursday, April 6, there will be a symposium on the biological value of proteins with Roger B. Lueck, of the Research Department of the American Can Company, presiding. The opening address at the morning session will be delivered by Dr. H. H. Mitchell, professor of animal nutrition at the University of Illinois, whose subject will be the significance of the biological value of proteins. Dr. Max S. Dunn, professor of biochemistry at the University of Southern California, will speak on optimal growth, a criterion of the biological value of proteins and amino acids. Dr. D. Breese Jones, head of the protein division of the U. S. Department of Agriculture, will discuss the nutritional and supplementary value of some plant proteins. Other speakers at the morning session will be Dr. Anthony Albanese, of the department of pediatrics of the Johns Hopkins University, who will discuss amino acid analysis of some common vegetables, and Dr. William H. Adolph, a former professor of biochemistry at Yenching University, Peking, who will speak on the protein problem in China.

The afternoon session will be devoted chiefly to a series of papers on amino acids as follows: Dr. Richard Block, of the New York State Psychiatric Institute, on "a comparative study of essential amino acids in food proteins and some implications for nutrition"; "on the human requirements for amino acids" by Drs. John R. Murlin, Estelle Hawley and R. R. Sealock, of the School of Medicine of the University of Rochester, this paper to be read by Dr. Sealock; Dr. Sidney Madden, also of the School of Medicine, on "amino acids and plasma protein regeneration," and Dr. L. Emmett Holt, Jr., of the Johns Hopkins University, on "the pathological effects of specific amino acid deficiencies."

Dr. Frank G. Boudreau, executive director of the Milbank Fund of New York City, will give the concluding address on the impact of the war on the world food situation.

The program for Tuesday, April 4, will include a symposium on vitamin research given jointly with the Division of Biological Chemistry, and a symposium on carbohydrates for industrial use arranged in cooperation with Drs. Hilbert and Rice, of the Sugar Division. Papers for these sessions have not been announced.

A general session will be held on Wednesday morning, April 5, with Paul Logue, of the Monsanto Chemical Company, St. Louis, secretary of the division, presiding. Papers will be presented dealing with the application of chemical technology to agricultural and food problems.

SCIENTIFIC NOTES AND NEWS

THE gold medal of the Royal Astronomical Society, London, has been awarded in recognition of work on the observation and interpretation of spectra of stars and nebulae to Dr. Otto Struve, director of the Yerkes Observatory, Williams Bay, Wis., and of the McDonald Observatory of the Universities of Chicago and Texas.

THE Warren Triennial Prize of $500 of the Massachusetts General Hospital has been awarded to Dr David G. Cogan, Dr. V. Everett Kinsey and Erwin O. Hirsch, of the Howe Laboratory of Ophthalmology of the Harvard Medical School, for an essay entitled "Physiological Studies on the Cornea."

DR. WALTER B. CANNON, George Higginson professor emeritus of the Harvard Medical School, visiting professor at New York University, was the guest of honor at a dinner given on March 8 at the Hotel Commodore, New York City, by the American Soviet Medical Society in recognition of his work on shock. The main address was made by Dr. Vladimir V. Lebedenko, Red Cross representative for the United States of the U.S.S.R.

DR. FREDERIC A. WOLL, professor of hygiene at the College of the City of New York, president of the State Board of Optometry, was the guest of honor at a reception given at the Hotel Pennsylvania on March 8 by the Optometrical Society of the City of New York. Professor Woll, who will retire from active service this year, was presented with a telescope. Dr. George B. Pegram, of Columbia University, made an address in appreciation of his work.

DR. THOMAS T. READ, Vinton professor of mining engineering at Columbia University, has been elected president of the University Kappa Chapter of the Society of Sigma Xi. Dr. S. R. Detwiler, professor of anatomy, has been made vice-president and Dr. John S. Karling, associate professor of botany, secretary-treasurer.

DR. WILBUR A. SAWYER, New York, was inducted into the presidency of the American Society of Tropical Medicine at the recent annual meeting. Dr. Rolla E. Dyer, Bethesda, Md., was chosen *president-elect;* Dr. Harold W. Brown, New York, *vice-president,* and Dr. Joseph S. D'Antoni, New Orleans, *secretary-treasurer.*

DR. WILLIAM CULLEN, consulting chemical and metallurgical engineer, has been elected president of the British Science Masters' Association in succession to Dr. Frederick Soddy, F.R.S., who until his retirement in 1936 was professor of chemistry at the University of Oxford.

SURGEON REAR-ADMIRAL G. GORDON-TAYLOR has been appointed Thomas Vicary lecturer of the Royal College of Surgeons, London, for the year 1944.

DR. ALEXANDER PETRUNKEVITCH, who joined the staff of the Osborn Zoological Laboratory of Yale University in 1910, becoming in 1917 professor of zoology, has retired.

SAMUEL NEWTON SPRING, since 1933 dean of the State College of Forestry at Syracuse University, will retire on July 1.

DR. HAMILTON H. ANDERSON, professor and head of the department of pharmacology of the Peiping Union Medical College, Peking, who recently returned to the United States, has been appointed professor of pharmacology at the Medical School in San Francisco of the University of California. He succeeds Dr. Chauncey D. Leake, who resigned to become vice-president and dean of the Medical Branch, Galveston, of the University of Texas.

DR. JAMES A. SHANNON, associate professor of medicine in the New York University College of Medicine, has been promoted to a professorship of pharmacology and has been made chairman of the department.

DR. WILLIAM H. NEWTON, head of the department of physiology at University College, London, has been appointed George Holt professor of physiology in the University of Liverpool. He succeeds Dr. Herbert Eldon Roaf, who is retiring.

DR. WALTER J. CRAIG, director of the division of orthopedics of the New York State Department of

Health, Albany, has retired. He will devote his entire time to the private practice of orthopedic surgery.

DR. OSKAR BAUDISCH, director of research at the Saratoga Spa, has been appointed a temporary collaborator in conjunction with members of the laboratory staff of the Plant Soil and Nutrition Laboratory at Ithaca of the U. S. Department of Agriculture, for work on boron and other "trace minerals."

DR. ROY M. SEIDEMAN, formerly of Rochester, N. Y., has been appointed industrial hygiene physician in the Bureau of the Connecticut State Department of Health at Hartford.

DR. JULIAN A. STEYERMARK, assistant curator of the herbarium of the Chicago Natural History Museum, on leave for government war work, has been transferred recently from Ecuador, where he was engaged in quinine investigations, and is now carrying on the same work in Venezuela.

IT is stated in the annual report for 1943 of the Rockefeller Foundation that Dr. Bernardo Houssay, of the University of Buenos Aires, who was one of the hundred and fifty distinguished citizens of Argentina dismissed from their posts for signing the petition "for effective democracy and American solidarity," is continuing research in a small laboratory established for him by an Argentine foundation. The Rockefeller Foundation has made a grant for equipment and supplies and for stipends to several young investigators who wish to work with him.

DR. ANTON J. CARLSON, professor of physiology emeritus of the University of Chicago, president of the American Association for the Advancement of Science, will be a guest speaker at the ninety-third annual session of the Iowa State Medical Society which will be held at Des Moines on April 20 and 21. His address will be entitled "The Physiological Aspects of Cardiac Disease."

DR. HERBERT GROVE DORSEY, of the U. S. Coast and Geodetic Survey, will lecture on March 25 before the Philosophical Society of Washington on "Radio Applied to Ocean Current Observations."

THE preliminary program of the fifth annual convention of the Institute of Food Technologists, which will meet on May 29, 30 and 31 at the Edgewater Beach Hotel, Chicago, has been issued. The meeting is being organized to cover three different aspects of food technology. The opening program will review developments since the last annual meeting at St. Louis in June, 1943. The speakers on the second day will discuss problems connected with the war effort, and the third and final session will be devoted to immediate future and post-war problems. Those wishing to attend are urged to make reservations for rooms without delay.

THE thirty-fifth annual meeting of the American Oil Chemists Society will be held at New Orleans from May 10 to 12. In addition to general papers there will be a symposium on the physical properties of fats and oils, which will include papers on x-ray and ultraviolet spectroscopy, specific and latent heats, viscosity and plasticity, and the practical application of physical methods of processing, including liquid-liquid extraction and continuous solidification of lubricating greases.

THE U. S. Senate voted on March 15 to authorize an expenditure of $20,000 to make the first over-all survey in sixty years of the fishing resources of the United States.

ACCORDING to *The Museum News*, the Michigan Planning Commission is presenting to the state legislature early this year a recommendation that one million dollars be appropriated to save the Porcupine Mountains area of the Upper Peninsula. The area has 46,000 acres and a 17-mile shoreline on Lake Superior.

BY the will of James Colby Colgate the sum of $100,000 is bequeathed to Colgate University, of which he was a trustee.

THE botanical library of Charles C. Deam, containing 3,500 bound volumes besides pamphlets, reprints and periodicals, has been given to the Deam Herbarium of Indiana University.

IT is reported in the *Journal* of the American Medical Association that two annual awards have been established under the sponsorship of the American Academy of Allergy. One is the Abbott Award, for both members and non-members of the academy, which consists of an annual prize of $200 established by the Abbott Laboratories of Chicago, to be granted annually for the most important advancement in the field of allergy or for the development of a research problem on any phase of the subject. The second award, to be known as the Secretary's Prize, is a medal to be given annually to a member of the academy for "the most outstanding achievement of the year in the general field of allergy."

ACCORDING to *The Experiment Station Record*, a recent news release from United China Relief announces that a small experimental farm is being conducted in Laurel, Fla., under the auspices of Lingnan University, one of the Christian colleges supported through United China Relief. This farm consists of about five acres, about fourteen miles south of Sarasota, where similarities in climate and growing conditions to those encountered in south China are making possible increased experimentation with Chinese plants which, although already introduced into the United States, have not yet been extensively grown here.

To enable graduates of high schools to advance

themselves a full year in chemistry in connection with the war emergency, the University of Pittsburgh will offer an eight-credit course in general chemistry during the eight weeks from June 26 to August 19. To enable college and university students to advance similarly, an eight-week course in organic chemistry will be offered for eight credits. Also beginning on June 26, twelve-week (full semester) courses will be offered in inorganic, analytical, organic and physical chemistry, and graduate courses in the field of advanced organic (type reactions and microanalysis) and physical chemistry, enzymes, kinetics and plastics. A special course covering "Recent Developments in Theoretical and Applied Chemistry" will be given for instructors in preparatory schools. Only full-time regular staff members will be in charge of these courses.

It is reported in *The Times*, London, that the plan to train 50,000 pharmacists in China during the next ten years is being helped by the Pharmaceutical Society of Great Britain, which is sponsoring a proposal to offer scholarships of £700, to include traveling expenses, for each of two years at the University of London to Chinese pharmaceutical graduates who undertake to return as teachers.

DISCUSSION

EDITORIAL CHANGES IN SCIENTIFIC PAPERS[1]

Professor Boyd's protest[2] against certain editorial practices deals mainly with the question whether such a term as "horse serum" is good English. That matter might have been disposed of more briefly. No one blessed with horse sense would call it "equine sense"; any one who did might arouse a horse-laugh. And if a serum obtained from a horse is "equine," one obtained from a donkey could only be "asinine."

More serious questions are brought up by Professor Boyd's observing that many manuscripts are completely reworked, and incidentally altered in meaning, without consulting the author. That seems hard to justify except on the ground either of great haste or of editorial infallibility. But the plea of haste would rarely be valid; and I have seen many manuscripts that had suffered editorial changes for the worse. As to matter that one sees only in print, it is impossible to determine just how good or bad the editing has been. Unfortunately for those who edit, their mistakes are open to the censure of critical readers, whereas the improvements they make are generally unperceived. It does not seem uncharitable, however, to assume that when a printed article contains obvious errors in syntax and punctuation, or when it is ineffective in ways that could easily be remedied, it has not been so well edited as it might have been; and that, it seems to me, is the case with much current scientific literature. If, as is probable, the faults of style in printed manuscripts were mostly in the original manuscripts and merely left in by the editors, most scientific manuscripts need more editing than they now receive. But more editing would not help unless it were good editing, and I believe that the quality of our editing could be improved (1) by assigning each of the several tasks that editing comprises to a person having special aptitude for that task, and (2) by humanizing the relations between editors and authors.

Editing begins with an administrative task, usually assumed by an editor in chief—that of determining what shall be published. Another task, essentially clerical, is the insuring of compliance with printers' conventions—including hyphens, for example, but not punctuation. A third consists in trying to improve the literary style by making it not only correct but effective.

For this work, which is what most people have in mind when they use the word "editing," I can think of no better name than "literary editing." One shrinks a little from using the word "literary," which may suggest, to some readers, endowing the style of all authors alike with qualities that are "literary" in the sense of "arty." But a good literary editor would surely not try to make either a G. K. Gilbert or a John Doe write like Walter Pater—nor yet like Ernie Pyle. He would always wish the style to be characteristic of its author's better self, and also suitable to its purpose, which would not be that of either Pyle or Pater.

By way of equipment, the literary editor would need more than a little stock of rules learned by rote, eked out with a few taboos, in the dim light of which he might revise each sentence by itself until it was grammatically correct. One who works in such a fashion may forget that a sentence can be correct and yet absurd when considered in relation to its context. Good editing, like all intelligent reading, all effective writing, and all rational thought, is a matter of relations. A good editor, therefore, will not be exclusively concerned with mere correctness; he will try to help the author make relations clear, and to bring out the relative importance of things by proper distribution of emphasis. He needs a literary sense, which I take to mean good judgment, drawn from a store of subconscious memories of his reading, as to what constitutes good usage. He needs also a critical sense,

[1] Published by permission of the director of the Geological Survey, U. S. Department of the Interior.
[2] Science, 98: 197, August 27, 1943.

in order to see what is wrong when he has trouble in understanding what the author says, or when his interest flags, and in order to find a remedy. The critical temper is commonly regarded, indeed, as unamiable, but a literary editor who was not critical would be no better than a piano-tuner who was tone deaf. Without a critical sense, the literary editor could not do what he has most at heart, which is to help the author make the best of his case.

He must also instinctively desire, one would imagine, to make his purposes understood by the author. That he can do to some extent by writing explanatory notes on the manuscript, and by sending a letter to the author when the manuscript is returned to him for consideration. The most obvious reason for sending back the edited manuscript is to give the author a chance to correct possible alterations of meaning. But the marginal notes and a considerate personal letter will, moreover, dispose him to consider the changes on their merits. When he can do that, he is likely to accept rather extensive changes without protest, and to point out those that he thinks unwarranted with some degree of good humor. When, on the other hand, he finds unexplained alterations in a proof that is accompanied by a request to "correct only typographical errors," his judgment is clouded by a sense of injury; he sees only the changes that he dislikes, and is in no mood to appreciate other changes which, could he consider them calmly, he might gratefully acknowledge to be improvements.

Other good effects are likely to ensue. The author may learn something that will make him write a little better for the rest of his life. Yes, and the editor may learn something to his own equally lasting advantage. A breaking down of icy walls, a climbing down from ivory towers, a letting in of air, would make for better editing as well as better writing.

FRANK C. CALKINS

GEOLOGICAL SURVEY,
WASHINGTON, D. C.

E. H. MCCLELLAND, in his retort[1] to Dr. Boyd's objections to arbitrary editorial changes of nouns to adjectives[2] makes the flat statement that it is a fallacy that parts of speech may be connected without the use of connectives. One would like to know his authority for this statement. Whatever its basis, the rule seems definitely disproved by the facts that (a) languages exist, like Chinese, in which no connectives are ever used, (b) the English language is full of expressions, such as "fence post," "rat poison," "medicine man," etc., which demonstrate very clearly that the use of nouns as adjectives, at least in a great many cases, is consistent with the genius of the language. No connectives are used in such expressions, and none are needed.

Whereas the traditional usage sounds familiar and is understood, the "reformers," who apparently want an adjectival form for every noun used as an adjective, seem to be attempting to foist off on us forms which are unnecessary and repugnant, such as "tetanal toxin," "porcine serum," etc. Furthermore, Mr. McClelland ignores the fact that in many cases the change to an adjectival form actually alters the meaning of the expression. "Porcine," for example, is certainly generally used to mean "looking like a pig," and we do not want to imply that there is anything piggy about the appearence of pig serum. Some pedants might perhaps say that in spite of this unfortunate connotation of "porcine," it should still be used instead of pig in expressions in which "pig" functions as an adjective, just to keep the proportion of adjectival form in use as high as possible. These same persons, however, would probably not consider changing "body blow" to "corporeal blow." As a matter of fact, in general, changing nouns to adjectives has an effect on the meaning which the proponents of the measure seem to ignore. It adds an attribution, often absent when the modifier is a noun, of the properties of the modifier to the noun modified. Thus "funeral parlor" means simply a parlor for funerals, whereas "funereal parlor" means a parlor which is "sad and solemn; dismal; mournful" (and not necessarily used for funerals). This fact probably partly explains the irritation felt by authors at finding nouns in their manuscript changed to adjectives on the printed page.

The most important point of all, however, seems to be that such changes of ordinary expressions into extraordinary expressions simply add another overtone of the bizarre to what is in too many scientific papers an already somewhat strained and unnatural style. They make it more difficult for the reader to find out what the author is trying to say, and this is often difficult enough, particularly when the subject is not too familiar to the reader. Even if there were some philological reason for wanting the change (which there is not), it would still be desirable to avoid it, since the primary purpose of writing, of scientific writing at least, is to convey something to the reader.

SAUL MALKIEL

BOSTON UNIVERSITY
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IN Dr. Boyd's paper published in SCIENCE on August 27, 1943, he stated most effectively the position against "Arbitrary Editorial Changes in Scientific Papers" (or in any other signed papers, for that matter). Dr. Boyd supported his arguments on the basis of: (1) the genius of the English language, citing philologic authority; (2) the preferences of scientific writers; (3) clarity, and (4) the right of an author

[1] SCIENCE, January 21, 1944.
[2] SCIENCE, August 27, 1943.

not to have changes made in his work without his permission.

In his letter of January 21, 1944, E. H. McClelland ignores Dr. Boyd's reasoning and supports his objection to Dr. Boyd's position solely by the statement that "equine serum" is exact and can not be misunderstood, whereas "horse serum" might be interpreted to mean a number of different things.

According to the definition, given in Webster's New International Dictionary, of "equine" when used as an adjective, "equine serum" might mean "serum of a horse," "serum pertaining to a horse," or, God save the mark, "serum resembling a horse."

Incidentally, what would Mr. McClelland prefer to corn whisky?

ROBERT J. LAWTHERS

BOSTON, MASS.

AN article appeared in SCIENCE (January 21, 1944) written by E. H. McClelland, in which he justified the change made by the editor of some journal in a manuscript of Dr. William C. Boyd. Dr. Boyd objected to the change from "horse serum" to "equine serum." Mr. McClelland laments the omission of connectives in English speech which results in nouns modifying nouns and believes this practice is a serious factor in the impairment of the English language. He claims that the change from "horse serum" to "equine serum" not only elevates the words from the dismal category of bad English, but also restores them to the realm of clarity from that of ambiguity.

As grammar is the basis of correct speech, we violate one of its rules by permitting a noun to modify a noun. But since the pattern of language is subject to evolution, is there any reason why a noun may not transmigrate to an adjective?

And as for ambiguity even the dictionary does not claim that "equine" will define serum any more rigorously than "horse," for in Funk and Wagnalls' "New Standard Dicitionary" (unabridged) "equine" means "of, pertaining to, or like a horse," so one has still to make a choice to suit the context.

Also in that dictionary "horse" has done very well as an abortive noun and gallops over more than a page (!) as an adjective.

Perhaps the answer to all the argument is to confer on "horse" a new degree and give him his A.D.J. It is noteworthy that "human" has done as much for himself, so why not bestow a similar honor upon this other noble animal?

All of which may merely serve to evoke equine cachinnations.

ANN O. EDISON

WEST ORANGE, N. J.

IN the discussion of editorial changes in scientific papers started by Dr. William Boyd[1] and continued by E. H. McClelland[2] there is one topic of importance that is hinted at but, it seems to us, not sufficiently emphasized. Leaving aside the merits of the point principally at issue, the use of substantives to modify nouns, we have the question of authorship and responsibility. Is the author responsible for the language employed in the paper, or is the editor responsible? When the reader detects inaccurate statements or faulty grammar in a paper, should he blame the author or should he blame the editor? The position often taken, that the author should determine the content of the paper and the editor the form, is not tenable. Every scientist well knows that the alteration of a single word or the misplacing of a single comma may totally change the meaning of a sentence. There can be no satisfactory division of responsibility unless the editor is willing to make himself the joint author of every paper.

It appears that friction between editors and authors could be avoided if they would govern themselves by the following principles. No editorial alterations, however trifling, shall be made without the consent of of the author. Consent may be given verbally, or by initialing a proof. If the author is furnished with a proof that is not in exact agreement with the copy he shall be privileged to approve it, to insist that it be made to agree with the copy or to withdraw the paper. But if the proof is typographically correct and in exact agreement with the copy, the author shall be bound to approve it without change, if the editor insists.

G. M. CLEMENCE
PAUL HERGET

U. S. NAVAL OBSERVATORY

SCIENTIFIC BOOKS

VITAMINS AND HORMONES

Vitamins and Hormones. Advances in Research and Applications. Edited by ROBERT S. HARRIS and KENNETH V. THIMANN. Volume I. With a foreword by E. V. MCCOLLUM. 1943. New York: Academic Press, Inc., Publishers. Price, $6.50.

THE present volume of "Vitamins and Hormones" constitutes the beginning of a new periodic publication and is planned to be the first of a succession of yearly volumes, which—in the words of the editors—

[1] SCIENCE, August 27, 1943.
[2] SCIENCE, January 21, 1944.

"will chronicle progress and point the way to new achievements." In his foreword Professor E. V. McCollum rightly points out "that the time is ripe for the founding of such a venture, since it is no longer possible for any one to read sufficient of the current papers and the library files dealing with these two classes of substances to assimilate all the knowledge which has accumulated."

Whereas the "Annual Review of Biochemistry" brings only reviews limited more or less to the publications of one year, giving a very comprehensive picture of this one year's work with the inclusion of vitamins and hormones, the present publication "Vitamins and Hormones" endeavors to interpret the records of many years in their relation to a few special problems. Thus the limitation lies here not in the time element but in the selection of the subjects to be incorporated in the current volume.

The high biological activity is the most conspicuous common link between vitamins and hormones. Hormones as endocrine products contribute in a large, even decisive manner to determining constitutional reactions, within physiological or pathological range. Vitamins introduced in the body with the food have a similar capacity in many respects. Here is a future possible field of research, the opening of which might be facilitated through the intermediary of "Vitamins and Hormones."

In the present first volume the scale is tipped rather in favor of vitamins. Of ten chapters two and part of a third contribution deal with hormones. The extraordinary achievements of the last 10 to 15 years in the chemical research of sex hormones are representatively reviewed by G. Pincus and W. H. Pearlman who wrote on "The Intermediate Metabolism of the Sex Hormones" and by T. Reichstein and C. W. Shoppee, whose subject is "The Hormones of the Adrenal Cortex" with special reference to the chemistry of cortical steroids. Pincus and Pearlman discussed the chemical reactions and transformations of the sex hormones in the body and *in vitro*.

"Physical Methods for the Identification and Assay of Vitamins and Hormones" is the title of the chapter written by J. R. Loofbourow. Spectrophotometry, colorimetry and fluorophotometry are described, analyzed and critically compared. For isolation, identification of the substances in quest, for determination of their purity the spectrophotometric method has its advantage. For assay procedures, so far vitamin A, α- and β-carotene and especially for esterone and androsterone colorimetric methods are just as good or even better than spectrophotometry. In the case of thiamine and riboflavin, fluorophotometry is by far the most sensitive of the assay methods.

The first chapter in the volume was written by C. C. Lucas and C. H. Best. Perhaps on account of his special and therefore biased interest in the subject, the present reviewer feels that this report is in almost every respect beyond possible criticism and was the best possible selection as an introductory contribution. Lucas and Best give a concise, clear and objective résumé of various problems connected with choline as a dietary factor. Choline "should take its place with the other members of the B complex from which it can not now legitimately be separated in any complete consideration of metabolic changes." The interrelation of choline, methionine and cystine is discussed by Lucas and Best in great detail, with special reference to the phenomenon of transmethylation (and dimethylation) as first formulated by du Vigneaud and his group. The questions whether choline and methionine are the only effective lipotropic factors, and whether the lipotropic activity of a protein is sufficiently determined by its relative content of methionine and cystine are left open. With Griffith the anti-lipotropic activity of cystine is considered by Lucas and Best as probably non-specific and due to the raising of the metabolism nearer to the normal level thus resulting in an increased demand for lipotropic factors. The present reviewer is not in agreement with this assumption and is in favor of assigning to cystine a specific role not only with regard to its anti-lipotropic activity but especially with regard to the experimental finding that whereas cystine alone is anti-lipotropic and promotes hepatic injury (necrosis and especially cirrhosis), given in combination with choline it is more beneficial than choline is alone. These and similar problems are now in the center of research activities. Workers engaged in this field should not miss the close study of the excellent report of Lucas and Best.

"The Appraisal of Nutritional States" is reviewed from the point of view of a clinician by N. Jolliffe and R. M. Most. Evidence for the prevalence of malnutrition is adduced from mortality statistics, morbidity rates, dietary surveys and from food supplementation. Under the factors contributing to nutritional failure the most important are intercurrent illnesses of great variety. The recognition of nutritional inadequacy is based on dietary, medical history and on the results of special examinations, using purely clinical and laboratory methods.

The title of the chapter, "The Chemical and Physiological Relationship Between Vitamins and Amino Acids," written by H. H. Mitchell is misleading. This report deals not only with amino acids but also with amino acid derivatives and with proteins as "amino acid aggregates." In consequence, the territory to be covered is too far extended and the views given are seen more from a distance than in their details.

R. P. Hall with his contribution did a real pioneer service summarizing the few available research data on "Growth-Factors for Protozoa." Here is a field which undoubtedly will receive more attention in the years to come.

G. R. Minot and M. B. Strauss in their masterly contribution on the "Physiology of Anti-Pernicious Anemia Material" were able to draw from rich experimental and clinical material of past studies.

In his chapter on "The Significance of the Vitamin Content of Tissues," R. J. Williams introduces the interesting problem of vitamin distribution. Special emphasis is laid on the significance of such distribution with regard to the functioning of the respective vitamins and also to the correlation with respiratory activity of tissues. More data have to be collected before generalization can be made.

The last contribution to be reviewed is that of G. Wald on "The Photoreceptor Function of the Carotenoids and Vitamins A." It is one of the outstanding chapters in the volume and its study should be highly recommended. It gives a lucid, logical exposition of all the available findings as gathered mainly from the research of the author. His conclusion, based on comparative physiology of photoreception, is that all photosynthetic cells appear to contain carotenoids, beginning from carotenes, xanthophylls, through astaxanthin in protistan phototaxis to vitamin A_2 (in fresh-water vertebrates) and finally to vitamin A_1 with active and determining participation in the primary processes of photoreception.

The volume contains a complete and useful subject and author index in addition to the bibliographic references attached to each chapter. (The latter are not handled with complete uniformity throughout the volume).

Workers in the fields of vitamins and hormones will gratefully acknowledge the present first volume of "Vitamins and Hormones" and will wish to the editors, to their contributors and to the publishers success for the future.

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ORGANIC CHEMISTRY

Electronic Interpretations of Organic Chemistry. By Arthur Edward Remick. v + 474 pp. 19 figs. 13.8 × 21cm. New York, N. Y.: John Wiley and Sons, Inc. 1943. $4.50.

The purposes of the book, as stated in thé preface, are to review the contributions of physical chemistry to the theory and practice of organic reactions and to teach the organic chemist how to apply the new knowledge in attacking his problems. The task of relating physical properties with structure is not undertaken.

The first four chapters trace the historical development of the electronic concept of chemical bonds and reactions, emphasis being placed on aspects of interest to organic chemists. The long chapter V outlining the electronic theory of the English school of organic chemists contains a clear exposition of the many principles developed for the explanation and prediction of the course of organic reactions. In the sixth chapter the nature of resonance and its significance to organic chemistry is presented with acknowledged indebtedness to Pauling's "Nature of the Chemical Bond." Chapter VII, concerned with contributions of kinetics to organic reactions, describes the Eyring-Polanyi transition-state theory of reactions, Hammett's work on the importance of the entropy factor in the rates of organic reactions and Remick's thermodynamic prediction of reaction mechanism and rates. There follows a chapter on electrochemical studies of organic oxidation-reduction reactions. Chapter IX discusses the characteristics of electron-pairing reactions (a new term for reactions involving free radical intermediates), and a thermodynamic method for estimating quantitatively the products formed. In the penultimate chapter the quantitative and qualitative effect of solvent changes on the thermodynamic possibility and kinetics of organic reactions is elucidated, leaving little doubt of the importance of these matters to organic chemists. The last chapter, brief for one dealing with displacement reactions, reviews the mechanisms of hydrolysis of alkyl halides and carboxylic esters, elimination reactions and olefin addition reactions.

By title and content this book has been written for the large number of organic chemists who desire a working knowledge of modern theories of organic chemistry. Realizing that the complexity of organic molecules makes the application of qualitatively valid concepts of wider use than quantitative estimations, Professor Remick has been careful to designate fundamental principles by number and to summarize them conveniently at the end of the book. These principles are simple to learn but present difficulty in application, overcome only by practice and study of many examples. While the number of examples is greater than that found in the other books on theoretical organic chemistry, the reviewer feels that the progress of an initiate will be impeded by the comparative paucity and simplicity of the examples. Furthermore, the majority of illustrations exemplify the old English idea of mesomerism or electromeric shift. Subsequent discussion of the nature, advan-

tages and applications of resonance is inadequately illustrated, and does not replace the idea of mesomerism by the more general conceptual scheme of resonance.

Somewhat surprising is the omission of the few principles delineating the characteristics and generalizing the behavior of carbonium ion intermediates. Some of the reactions, intelligent understanding of which is made difficult by the omission, are the Wagner-Meerwein rearrangement, the reaction of diazomethane with ketones, the reaction of nitrous acid with primary amines and the Friedel-Crafts reaction. Among other important topics not treated is the work of Lucas and Winstein in which they produce convincing evidence for the bromonium ion intermediate, important in the displacement reaction and mechanism of addition to olefins.

There is at present no single book fulfilling the requirement of organic chemists and since many subjects are well discussed and comprehensively reviewed in Professor Remick's book alone, it is another work of circumscribed organic applicability which will be useful for chemists seriously interested in studying modern theories of organic chemistry.

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REPORTS

WARTIME HEALTH AND EDUCATION[1]

THE decisive contribution of science and technology to the winning of the war is recognized by all. The maximum contribution of science is equally essential in the postwar development of America. A nation free from fear and free from want, a nation which guarantees to its citizens a Bill of Economic Rights, is possible only with continued scientific research and development.

Scientific workers are as widely varied in economic status as the workers in any other field. The term "scientist" describes the $25,000-a-year director of an industrial laboratory as well as the $1,500-a-year laboratory worker in a hospital or school. There has been great variability moreover in wartime changes in the salaries of scientists. Many workers in the field of physics have left their jobs to go into war work, often at a considerably higher salary. But in government and academic science, particularly in the biological branches, scientists have in most cases remained at their pre-war positions, with rigidly fixed pre-war salaries.

It is unfortunate that no adequate data are available on the economic status of scientists; but from the meager information at hand, one can safely conclude that large numbers of American scientists are receiving salaries in the neighborhood of $150–$200 a month, or between $35 and $50 a week.

Even where salaries have increased in the course of the present war, they have been largely offset by increased taxation and the rise in the cost of living. All scientists—not only those in the lower income groups—have a great stake in the quick institution of the complete stabilization program proposed by President Roosevelt. Unless the current trend to inflation is halted, the scientist, along with all other professionals, will be faced with a serious situation which is bound to reduce the effectiveness of his contribution to the nation.

A wartime problem which many scientists face is that of the difficult living conditions in "war-boom" communities. Many scientists from distant parts of the country have been brought to communities where living costs have risen far more than for the country as a whole and where housing facilities are wholly inadequate to meet the new demands.

Scientists, perhaps more than most professional and white collar workers, are involved in war work for which they are paid, directly or indirectly by the Federal Government through such agencies as the Office of Scientific Research and Development and the National Defense Research Council. Unless a proper plan of action is followed by the Federal Government in turning from the wartime to a peacetime economy, there will be disastrous economic dislocations among scientific workers after the war. This would be both a personal and national calamity. As has already been indicated, the maximum contribution of all scientists is as essential to the welfare of the people after victory as it is now.

The American Association of Scientific Workers suggests the following steps, which would help to avert such economic dislocation:

(1) Continuation and expansion of governmental financing of scientific research, through subsidies to universities and other academic institutions as well as through the expansion of the government's scientific and technical agencies. Only by such governmental action can the full scientific skills developed during the course of the war be used.

(2) Continue the activities of the National Roster of Scientific and Specialized Personnel, with increased possibilities of functioning in a broader way, in the selection and placement of scientific personnel after the war.

(3) Those scientists who have left their homes to do

[1] Summary of statement presented to Senate Sub-committee on Wartime Health and Education on January 27, 1944, by Dr. Kirtley F. Mather, president of the American Association of Scientific Workers.

war work in some other part of the country and who wish to return to their original jobs and homes should be considered as drafted men and women returning from service to their country. Every effort should be exerted to make their former jobs available to them. They should be furnished with severance pay sufficient to get them back to their homes and over the initial hard times. This is just as much a national responsibility as that recognized in giving "mustering-out pay" to members of the armed forces.

SPECIAL ARTICLES

CHEMOTHERAPY OF FILARIASIS IN THE COTTON RAT BY ADMINISTRATION OF NEOSTAM

FLORIDA cotton rats are frequently infected with a filarial worm, *Litmosoides carinii*. The adult parasites dwell in the pleural space and microfilariae occur constantly in the peripheral blood of the rats. Since infected animals can be readily procured and since the infection bears some similarity to certain of the human filarial diseases, the cotton rat filariasis appears to supply a much-needed means of testing drugs for potential activity in the treatment or prophylaxis of human filariasis.

Several drugs have been tested in this laboratory for therapeutic action in the cotton rat infection. Among these, neostam (stibamine glucoside, Burroughs Wellcome and Co.) has given particularly favorable results. The adult filarial worms have been killed after a few doses of this drug and gradually thereafter microfilariae have disappeared from the peripheral blood of treated animals.

In Table 1 are given data on ten treated and two control untreated cotton rats. Four doses of neostam, each of from 40 to 60 mgm, were administered intramuscularly to the animals every week until autopsy and microfilaria counts on the tail blood were made almost every day. The animals were autopsied after the intervals indicated in the table and searched for adult worms. In the treated rats presented in the table, in which the microfilaria count finally reached zero, every adult worm was dead when recovered at autopsy. Usually the adult worms from the treated rats were found massed together, often completely enveloped by inflammatory exudate. In other treated rats, besides those shown in the table, which were autopsied before all microfilariae disappeared from the peripheral blood, the adult worms were likewise dead and enveloped by exudate, in some animals after as brief a time as eleven days from the beginning of treatment. It appears from these data that the repeated injection of neostam has resulted in the cure of filariasis in the cotton rat and, since the drug is well tolerated by man in comparatively large doses,[1] its trial in human cases of filariasis seems to be indicated.

TABLE 1

EFFECT OF NEOSTAM ON THE FILARIAL WORM LITOMOSOIDES CARINII IN COTTON RATS

Cotton rat No.	Microfilariae counted in 100 microscope fields × 430 on designated days											Adult worms recovered at autopsy†
	Before treatment	After treatment										
		1	7	14	21	28	35	42	49	56	64	
1	136	94	100	52	20	28	16	7	5	2	0*	40 to 50; dead; matted together.
2	44	0	4	3	5	5	1	3	1	0*		5 to 10; dead; enveloped by exudate.
3	50	28	32	22	24	28	4	1	3	1	0*	10; dead; matted together.
4	4	4	0	0	0	0	0*					1; dead
5	12	10	0	0	0	0	0*					10; dead; enveloped by exudate.
6	92	62	92	70	38	7	6	6	0	3	0*	50; dead; some matted together.
7	180	152	230	84	16	64	8	3	2	1	0*	50; dead; matted together.
8	92	72	16	4	0	0	0*					25; dead; enveloped by exudate.
9	124	44	56	0	0	0*						20; dead; enveloped by exudate.
10	108	96	116	62	26	5	0*					40; dead; some matted together.
11 (Control)	16	18	36	12	24	20	10	38	48	42	52*	8; living; freely moving.
12 (Control)	252	232	232	176	110	192	90	176	136	186	198*	50; living; freely moving.

* Day of autopsy.
† When worms are matted together, numbers are approximated.
Schedule of treatment: Rats 1 through 7: 40 mgm } 4 times weekly until autopsy.
Rats 8 through 10: 60 mgm }
Rats 11 and 12: Untreated controls.

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THE ROLE OF CALCIUM IN CARCINOGENESIS

IN a comprehensive review on the role of the fixed bases in cancer, Shear[1] pointed out that "much con-

[1] L. E. Napier, *Indian Jour. Med. Res.*, 16: 911, 1929.
[1] M. J. Shear, *Am. Jour. Cancer*, 18: 924, 1933.

fusion exists as regards the role in cancer of the commonly occurring constituents, sodium, potassium, calcium and magnesium."

In our integrated program on epidermal methylcholanthrene carcinogenesis in mice quantitative determinations of the fixed alkalies and of iron in normal, in benzene-treated and in methylcholanthrene-treated epidermis have been carried out.[2] These investigations showed that one application of methylcholanthrene reduced within 10 days the epidermal calcium and iron content to 50 per cent. of the normal, benzene alone being without effect. Tri-weekly treatments of the epidermis with the carcinogen for 60 days did not cause a further significant decrease in the calcium content, although the epidermal hyperplasia was more extensive than after a single application at 10 days. The next step was to determine the content of this metal in a carcinoma derived from mouse epidermis. For this purpose a rapidly growing transplantable carcinoma,[3] produced in the skin of a Swiss mouse by methylcholanthrene, was used. The methods for the determination of calcium[4] and for nucleoprotein phosphorus, (N.P.P.) the basis of reference, have been given.[5] For analysis the carcinomas were cleaned of adhering blood and connective tissue after removal and then cut in small pieces and thoroughly mixed before sampling. A small piece of each tumor used for analysis was fixed for microscopic examination to determine the extent of necrotic tissue present.

Since transplantable tumors may contain variable amounts of necrotic tissue and since such necrotic tissue is known to be rich in calcium,[1] it was necessary to exclude as far as possible the presence of necrotic tissue. This was accomplished by using young tumors, 10 to 14 days after inoculation, at which time they are small, solid, and contain little, if any, necrotic material. Six to 12 tumors were required for a single analysis.

The calcium content was determined in nine different samples. The results, together with those of normal, benzene-treated and epidermis, rendered hyperplastic by the carcinogen, are shown in Table 1. The Ca/N.P.P. ratio of hyperplastic epidermis was 50 per cent. less than normal, and that of the carcinoma about 50 per cent. less than the hyperplastic epidermis. The calcium content of the carcinoma varied from 0.007 to 0.014 mg calcium per 100 mg tumor.

With the microincineration technique Paletta, Cowdry and Lischer[6] found demineralization in both benign and methylcholanthrene, hyperplasia, particularly in the distal part of the spinous layer. With the same method Scott[7] reported that hyperkeratosis, warts, human breast and skin carcinomas showed much less calcium and magnesium in their cytoplasm than did similar normal types. However, it is not possible to distinguish between calcium and magnesium by the microincineration technique.

TABLE 1

Tissue	No. of analysis	Mg. calcium per 100 mg tissue average	Mg. nucleoprotein phosphorus per 100 mg tissue	$\frac{\text{Calcium}}{\text{Nucleoprotein phosphorus}} \times 10$
Normal epidermis	6	0.044	0.118	3.60
Benzene-treated epidermis ..	7	0.042	0.125	3.40
Methylcholanthrene-treated epidermis (hyperplastic) .	18	0.019	0.130	1.46
Carcinoma ...	9	0.009	0.121	0.75

The extent to which the presence of necrotic tissue affects the calcium content was determined by the analysis of the same strain of transplantable tumor in the groups (Table 2) of older tumors in which necrotic tissue was visible to the naked eye. In Group B, C and D this poorly visible necrosis was verified histologically.

TABLE 2

	Mg Ca per 100 mg tumor Average	Ca/N P.P. × 10 Average
A. Large necrotic tumors ...	0.077	
B. Large necrotic tumors freed of gross necrotic material	0.042	3.42
C. Tumors about 15 mm in diameter freed of gross necrotic material	0.029	2.49
D. Tumors about 10 mm in diameter freed of gross necrotic material	0.019	1.61

These results show the effect of including necrotic material in the tissues analyzed and the importance of excluding it in determination of the calcium content of the actual neoplastic tissue.

SUMMARY

Estimations of the calcium content of the mouse epidermis during the process of experimental carcinogenesis reveal two distinct phases: an immediate reduction in the calcium content which persists at a fairly constant level for many weeks and a further reduction when the epithelial cells have been transformed into cancer cells. Reduction of calcium in the

[2] C. Carruthers and V. Suntzeff, *Cancer Res.*, 3: 744, 1943.

[3] The authors are indebted to Dr. Z. K. Cooper of this hospital for the carcinoma.

[4] V. Suntzeff and C. Carruthers, *Cancer Res.*, 3: 431, 1943.

[5] C. Carruthers and V. Suntzeff, *Jour. Nat. Cancer Inst.*, 3: 217, 1942.

[6] F. X. Palletta, E. V. Cowdry and C. E. Lischer, *Cancer Res.*, 1: 942, 1941.

[7] G. H. Scott, *Biological Symposia*, 10: 277, 1943.

hyperplastic epidermis is an important feature in this experimentally induced precancerous condition.

This investigation was aided by grants from the International Cancer Research Foundation and the National Cancer Institute.

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SURVIVAL OF NORMAL CELLS IN PENICILLIN SOLUTIONS LETHAL TO MALIGNANT CELLS

STUDIES at the Wistar Institute of Anatomy and Biology, made possible through the kindness of Dr M. R. Lewis and Dr. W. H. Lewis,[1] have revealed a selective lethal effect of penicillin upon rat and mouse sarcoma cells, of which a full account will be published later.

In roller tube cultures, untreated sarcoma cells, grown with normal fibroblasts derived from explants of muscle from the same strain of tumor host, grow fully as vigorously as the normal cells. However, upon addition of penicillin (Squibb's sodium salt of penicillin), the sarcoma cells were selectively damaged. With proper choice of the dosage level, it was found possible to kill all the sarcoma cells without damaging the normal fibroblasts. Higher dosage damaged the non-malignant cells, but the dose required was two to three times that required to produce an equivalent injury in malignant cells.

Damage was arbitrarily classified as incipient (granularity of 50 per cent or more of the cells, and a faintly withered appearance of the cell membrane), marked damage (rounding, coagulation or disintegration of the cells, short of 100 per cent), and lethal (no living cells visible). Table 1 shows the totals of explants classified according to damage shown. These results include four induced rat tumors and one induced mouse tumor. Another induced mouse tumor, not included in the data of Table 1, did not show a definite selective response.

TABLE 1

NUMBERS OF EXPLANTS OF SARCOMA CELLS AND OF NORMAL FIBROBLASTS SHOWING DIFFERENT GRADES OF DAMAGE. COMBINED TOTALS OF ALL EXPERIMENTS

	None	Incipient	Marked	Lethal	Totals
Normal	112	37	57	0	206
Sarcoma	0	29	156	78	263

In twenty-five experiments, the treated tumor cultures were implanted into rats of the corresponding 100 per cent-susceptible strain. All cultures graded as "lethal damage," and most of those graded as "marked damage" failed to produce tumors, whereas the untreated cultures produced tumors.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A RAPID, QUANTITATIVE METHOD FOR THE DETERMINATION OF PENICILLIN

THE following assay method affords a rapid, convenient and relatively accurate method of determining the potencies of antibiotic substances in terms of suitable standards. Since assays may be completed during the course of a working day, the method is particularly useful as a guide to the time of maximum production of penicillin, for the control of isolation procedures of various antibiotic agents, in the determination of the amount of deterioration and for related problems.

Earlier experiments[1] on the use of filter paper as a matrix to support mold growth led to the development of the present assay method in which the antibiotic substance to be assayed is placed on sterile, absorbent paper discs on the surface of inoculated nutrient agar. The function of the paper is to act as a reservoir from which the antibiotic substance diffuses into the agar where it inhibits the growth of the test organism. This results in a clear zone surrounding the disc. It was found that the diameter of this zone of inhibition is proportional to the amount of antibiotic substance present and, for practical purposes, may be considered a straight-line function of the log concentration.

The following example illustrates the simplicity of the assay. Nutrient agar,[2] approximately pH 7.0, was seeded with *B. subtilis* spore suspension[3] so as to contain approximately 2×10^5 spores per cc and 25 cc portions of this medium were pipetted into 90 mm petri dishes (depth of the agar approximately 4 mm). Four sterile, filter paper discs, diameter 15.3 mm,[4] were evenly spaced upon the agar. By means of a

[1] We are indebted to the Carnegie Institution of Washington Department of Embryology and to the International Cancer Research Foundation, as well as to the Wistar Institute of Anatomy and Biology, for aid in carrying out this work.

[1] M. B. Sherwood, *Jour. Bact.*, 43: *Proc.*, 779, 1942.

[2] G. L. A. Ruehle and C. M. Brewer, *U. S. Dept. of Agriculture Circ.* 198, 1929.

[3] J. W. Foster and H. B. Woodruff, *Jour. Biol. Chem.*, 148: 723, 1943.

[4] Discs were cut from E. and D. No. 615 filter paper with a sharpened cork borer.

4 mm, 24-gauge nichrome wire loop,[5] 2 loopfuls of the undiluted standard (in this case a *P. notatum*[6] filtrate of known potency) were placed upon one disc and, after flaming the loop, a second disc was treated with 2 loopfuls of 1:4 aqueous dilution of the standard filtrate. Similarly, 2 loopfuls of the undiluted unknown (the unfiltered infranatant solution from a growing culture) were placed on the third disc and 2 loopfuls of a 1:4 dilution of the unknown on the fourth disc. Plates were prepared in quadruplicate and incubated immediately after treatment. An incubation period of 5½ hours at 37° C resulted in growth sufficiently heavy to permit measurement of the clear zone of inhibition with a mm rule. The results are given in Table 1.

TABLE 1
DIAMETER OF ZONES OF INHIBITION IN MM

	Standard		Unknown	
	Diluted 1 to 4 or 25 per cent.	Undiluted or 100 per cent.	Diluted 1 to 4 or 25 per cent.	Undiluted or 100 per cent.
Plate I ...	27.5	32.5	23.5	29.5
Plate II ..	27	31.5	23	28
Plate III ..	26.5	31	24	29
Plate IV ..	27	32	25	30
Sums ..	$108.0 = S_1$	$127.0 = S_2$	$95.5 = U_1$	$116.5 = U_2$

The potency expressed as percentage of the standard may be readily calculated with the aid of the following simple equation[7] in which 2 is the factor for converting to per cent., d is the log of the ratio of the greater dose to the smaller dose (here $d = \log 4$ or 0.602) and the other terms are those indicated in the table.

$$\text{Potency} = \text{antilog}\left(2 + d\,\frac{(U_2+U_1)-(S_2+S_1)}{(U_2-U_1)+(S_2-S_1)}\right)$$

On substituting the data of Table 1, it was found that the unknown was 45 per cent. as potent as the standard.

$$\text{Potency} = \text{antilog}\left(2 + 0.602\left\{\frac{(116.5+95.5)-(127.0+108.0)}{(116.5-95.5)+(127.0-108.0)}\right\}\right)$$

$$\text{Potency} = \text{antilog } 1.6538 = 45\%.$$

Using the method of factorial analysis described by Bliss,[8] it was found that the average standard error was 4.3 and that the slope of the line was 8.3.

Illustrating the reproducibility of results, two independent workers assayed two different preparations and found 11 per cent. and 12 per cent. potency for the weaker solution and 80 per cent. and 84 per cent. for the stronger.

In these antibacterial assays, the loop was found to give the same order of accuracy as micropipettes but to afford greater ease of manipulation and to eliminate much washing and sterilization.

Up to the present, experiments have been done with penicillin, clavacin and gliotoxin. *B. subtilis* was found to be a more convenient test organism than *Staph. aureus*, *E. typhosa*, or *D. pneumoniae* types I, II and III.

Since the response is affected by the temperature and duration of incubation, the volume of the dose, the size of disc, the depth of the agar and the number of *B. subtilis* organisms per plate, these factors must be kept relatively constant. A more complete study of the method, together with data on the above-mentioned variables, will be presented elsewhere.

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[5] Constructed as described in reference 2. The use of short, wide tubes led to more uniform loopfuls of solution.

[6] The authors are indebted to Dr. K. B. Raper, of the Northern Regional Research Laboratory, Peoria, Ill., for cultures of *P. notatum;* to Dr. S. A. Waksman, of the N. J. Agricultural Expt. Station, New Brunswick, N. J., for a culture of *A. clavatus;* and to Dr. J. W. Foster, of Merck and Company, Rahway, N. J., for cultures of *Staph. aureus* and *B. subtilis.*

[7] The equation is derived as follows: The average of the responses for the standard solutions, $\frac{S_2+S_1}{2N}$ (where N represents the number of responses per dose), is subtracted from the average of the responses for the unknown solutions $\frac{U_2+U_1}{2N}$ and the resulting difference is converted into a logarithm by dividing by b_c, the average slope of the two dose-response curves. The antilog of this logarithm is the potency of the unknown in terms of the standard and may be expressed on a percentage basis by multiplying by 100. It is more convenient, however, to carry out this multiplication while the potency ratio is still in logarithmic form by adding it to 2, the logarithm of 100. Combining $\frac{1}{2}\left(\frac{U_2-U_1}{Nd}+\frac{S_2-S_1}{Nd}\right)$, which is the formula for b_c, with the above steps results in the following equation:

$$\text{Potency} = \text{antilog}\left(2 + \left[\frac{1}{\frac{1}{2}\left\{\frac{U_2-U_1}{Nd}+\frac{S_2-S_1}{Nd}\right\}}\right]\left[\frac{U_2-U_1}{2N}-\frac{S_2-S_1}{2N}\right]\right)$$

which reduces to the simple expression given in the text.

[8] C. I. Bliss and H. P. Marks, *Quart. Jour. Pharm. Pharmacol.*, 14: 182, 1939.

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THE ORGANIZATION, DIRECTION AND SUPPORT OF RESEARCH IN THE PHYSICAL SCIENCES[1]

By Dr. HUGH S. TAYLOR

PRINCETON UNIVERSITY

The Organization of Research

The American nation is in process of assuming, through the power of her military, naval and air forces, and the technological organization requisite to that power, a position of major responsibility for peace and civilization in the post-war era. Adequately to meet the commitments which such a responsibility entails, the United States will, of necessity, be forced to enlarge both political and social horizons and at the same time to develop, to a degree hitherto unrealized, the scientific bases which that enhanced influence in the counsels of the world will, in large measure, require.

The progress of science and the technological changes that have resulted therefrom have proceeded with auto-accelerating pace over the last thirty years. Some concept of what the coming decades may hold can be learned from the history of this country during World War I and the interwar years with respect to scientific achievement, and the pattern there revealed will be a miniature of what must inevitably follow from the revolutionary changes in technology that the present war has produced. In 1914 American science looked to Europe for leadership. As Dr. C. M. Stine noted in an address to American chemists one year ago:

> It was a simple, almost a scientifically primitive economy in which we Americans then lived. On all the seven seas, America-bound ships heavy with goods and raw materials testified to our dependency on foreign lands. The homes in which we lived differed little from those of our great-grandfathers; the tailors of the Caesars knew the textiles of which we made our clothes; the finishes of our

[1] Read on November 19, 1943, in the Symposium on the Organization, Direction and Support of Research of the American Philosophical Society.

1914-model horseless carriages dated to ancient Egypt and the building of the Pyramids. All steel rusted. The best rubber tires were worn out after about 3,000 miles of highly uncertain road service.

One shudders at what might be our plight if those were the tires of to-day, or if by some colossal blunder we had failed to establish an organic chemical industry in the United States as a consequence of that other war's bitter lessons.

Thank God, we did establish a chemical industry!

We did more than that. We established a nation-wide common consciousness of the power of science in every branch of American industry. Steel, textiles, transportation, foods, oil, in fact every basic producer, came to the turn in the lane where all signposts of progress pointed in one direction—to the research laboratory. We did not get there all at once, but most of us got there long before German hob-nailed boots were pounding over the streets of Warsaw.

Expenditures for industrial research in the United States rose from an inconsequential sum yearly in the pre-World-War-I period, to an amount estimated at $300,000,000 yearly in the pre-World-War-II period. The number of research laboratories grew to more than 2,000. Huge sums were spent in expanding technical and scientific schools to meet the demands of our awakened youth. The number of doctorates granted in chemistry alone was multiplied by 20 or 30 times.

Similar if less immediate changes occurred in the science and technology of physics with advances in communications and transport, based upon electronics and aerodynamics, reaching a tremendous pace of growth only within the last few years. Mathematics, pure and applied, shared in the effort and took its part in the scientific and technical educational task that was required. Immediately after World War I, when the impact of war had revealed the necessity for expanded training in science, the Rockefeller Foundation initiated through the National Research Council in Washington a series of post-doctorate national research fellowships in astronomy, mathematics, physics and chemistry. These fellowships aimed initially at the building up of a scientific personnel from which the required enlarged body of college and university science professors could be drawn. The record shows abundantly how this was in large measure accomplished, and in our present stress we can see how far-sighted the policy was and how much to-day we lean for leaders upon the men so trained.

Industry also found that the available number of graduate students was inadequate to the demands of rapidly expanding programs of industrial research and itself took a hand in stimulating the supply. The E. I. du Pont de Nemours Company initiated such a venture early in 1922. To a selected group of universities with good reputations in chemistry, the company offered to the department of chemistry a fellowship at the graduate student level without any restrictions as to choice of fellow, nature of the research work pursued or ultimate ambition of the student selected. The aim was frankly to increase the number of students pursuing work for the doctorate in chemistry. The philosophy behind the fellowships was that, ultimately, an increase in the number and quality of graduate students in chemistry would mean an improved research personnel in their own laboratories. The example of the du Pont Company has been widely imitated by other chemical organizations. In physics, the policy has been notably less evident, but the current demand for research men in physics suggests that a similar intensive development of graduate students is due.

The universities themselves have contributed generously to the expansion of research personnel by the system of part-time assistantships. Here, also, owing to larger elections in the chemical field, the expansion has been greatest in the departments of chemistry, but the current demand for physicists and the probability that it will continue suggest that a similar measure of expansion is at hand in physics. It is via this path that many of the research personnel in industry and university have obtained their training for the doctorate in America, at least during one or two years of their training period. It is largely from the ranks of such assistants that the best are drawn to fill fellowship vacancies in the final years of study and research where freedom from other obligations constitutes a prime asset.

The growth of the educational supply to meet the research demand has led inevitably to steady improvement in the quality of educational and research activity in American colleges and universities in the inter-war years. American science and scientists have, in the main, been prepared for the tremendous calls that the present war has laid upon them. Leaders in the scientific effort have received a generous measure of support from educational foundations. There has grown up as a result, in and out of the universities, centers of research devoted to a group of connected problems. Dr. C. E. K. Mees, of the Eastman Kodak Research Laboratories, classifies such laboratories "as 'convergent' in distinction from the more usual 'divergent' laboratories, in which problems of many kinds are studied." Such a laboratory of the convergent type may well be described, Dr. Mees believes, as a "research institute," and it is this type of research institute that he expects to be the most important of the agencies for the production of fundamental science in the future. The research institute is a growth of the last half-century in the organization of research. It has grown out of the specialization of investigators, generally at universities, in some field of

work important enough to attract students to the field and resulting finally in the establishment of the laboratory in question as the center for research in the subject. Abroad and at home many examples may be cited. The Cavendish laboratory at Cambridge, under J. J. Thomson for the study of the electron and under Rutherford for radioactive and nuclear studies, the Leiden laboratories under Kammerlingh Onnes for low-temperature research, are examples from universities abroad. The Kaiser Wilhelm Institute for Physical Chemistry in Dahlem under Haber is an example of a research institute that grew out of foundation foresight and generosity. The Geophysical Laboratory at Washington and the Mount Wilson Observatory are research institutes in this country established by the Carnegie Institution. The grant by the International Education Board for the 200-inch telescope on Mount Palomar, California, and the appropriation by the Rockefeller Foundation to the University of California for the construction of the giant cyclotron designed by E. O. Lawrence directly tend to make of these centers research institutes of the type under consideration.

To a lesser degree, over the whole country, monetary grants in support of promising research work and research men are producing research institutes convergent rather than divergent in nature, within the framework of existing universities or as separate organizations with some degree of affiliation with college or university. We may cite in this connection the Institute of Paper Chemistry at Appleton, Wisconsin, and the Institute of Gas Technology, with headquarters in Chicago. The American Petroleum Institute has made Ohio State University the headquarters of research effort which also provides materials for research work in many institutions. The American Petroleum Institute for many years has sponsored a large program of research in the U. S. Bureau of Standards in Washington. This is true, also, of the Textile Foundation, and from this research effort may spring a central institute for fundamental research in textiles, affiliated with some educational foundation. Cellulose chemistry, the chemistry of starch and of sugar, are examples of other research efforts which may mature into research institutes of the type here under discussion. Some of the industrial research laboratories can indeed be described as research institutes. The research laboratories of the Eastman Kodak Company at Rochester can be cited as a Research Institute for Photography. The research laboratories of the General Electric Company at Schenectady, of the Bell Telephone Company at New York City and Summit, N. J., and that of the Westinghouse Company at Pittsburgh, Pa., rate high among the research institutes of the country. In this last case, the institute aspect of the enterprise has been emphasized by the short-term fellowship scheme for post-doctorate research men that the Westinghouse Company has sponsored. The regional laboratories of the U. S. Department of Agriculture, with laboratories devoted specifically to research in the principal agricultural products of the East, South, Central and Western areas of the country, are government-sponsored research efforts of the research institute type.

In England, there are parallel developments. Under the Department of Scientific and Industrial Research there are organizations such as the National Physical Laboratory and the Government Chemical Laboratory, and also a number of industrial research associations notably in cotton, wool and silk. The British Rubber Producers Research Association sponsors a broad program of fundamental research on rubber. The Fuel Research Board has conducted a comprehensive program on liquid fuels during the years between the two World Wars, and plans for fundamental research on coal have developed during the present war years. Naturally, under the stress of war requirements, the scientific establishments, in England as here, devoted to the special problems of war urgency have multiplied considerably.

It is a matter of universal experience that the conduct of warfare, on the scale and with the equipment that modern technology has made possible, requires a tremendous research potential behind the actual military forces. It is not surprising, therefore, in the light of the achievements of the Russian forces during the last two years, that, in Russia, can be found the most extensive planned development of the research institute. The organization of these institutes has been described by J. G. Crowther in his book, "Soviet Science." They stem from the Russian Academy of Sciences, and, under separate committees of academicians and associates, various groups of institutes are organized in each field of science. Among the more notable of these are the Academy of Agricultural Science, with N. I. Vavilov, the eminent geneticist, as one of its outstanding members, the Physico-Technical Institute directed by Joffe, the Institute for Chemical Physics, associated with N. Semenov, and the Optical Institute, the three last with headquarters in Leningrad, the Karpov Institute of Physical Chemistry at Moscow, and many others. The year 1942 gave Russian Soviet science a welcome opportunity to summarize the progress which had been achieved in 25 years from the Revolution of 1917. In this process of self-examination it was, in one place, concluded without hesitation

> that Soviet science does not lag behind scientific achievements in other countries and that Soviet scientists are leaders in many branches of science. . . . The orginal plan for expansion of the chemical industry during the third

five-year plan (1938–1942) which provided for a 237 per cent. expansion of chemical industry is being stressed. The war did not decrease the scope of this development. It only brought forward the practical requirements of the day.

In addition to steel, non-ferrous metals and the heavy chemical industry, petroleum, synthetic rubber, plastics and the synthetic fiber industry were all included in the scope of the plans. The research effort by 1941 had resulted in 40 special chemical research institutes, 70 chemical and chemical engineering schools or departments in technical colleges, with from 35,000 to 40,000 students and some 5,000 chemists and chemical engineers graduated each year. The losses sustained in the initial year of war were compensated "with a substantial margin" by evacuation and resumption of work in research institutes, colleges and industrial establishments in the eastern territories of the Soviet Union.

Institutes of the type here considered can be in no sense regarded as substitutes for the industrial research laboratory. These latter are essential if the new developments in fundamental science are to be translated into industrial processes and products. The research institute must be regarded, with the university research laboratory, as the principal source of that body of fundamental science which the industrial research laboratory will bring into practical application. The energetic demands for applied science now with us due to war have only served to show, in sharper focus, how the solutions of desired industrial problems are oftentimes delayed by gaps in our fundamental knowledge. In the solution of pressing war problems how often have we to lose time in learning the science underlying the desired application. The industrial laboratory must look in large measure to the university and research institute, even in normal times, for such basic data. The advantage which industry would reap therefrom would lie not so much in the immediate returns from the fundamental research but in the speed and economy of effort with which industry can utilize such effort in the solution of its own practical problems. The contrast between American technology in World War I and to-day, in the volume of technical effort that it can put forth and in the speed with which new problems can be solved, is undoubtedly due to the great growth of fundamental science in this country in the inter-war years.

There is another aspect of the problem of organization for scientific research in the post-war world that is so comprehensive as to be outside the scope of our present considerations but nevertheless of extreme importance for the successful solution of the problem and the correlation of that solution with other aspects of post-war life. It will be necessary to re-examine the general processes of education at the primary, high school and college levels if we are to provide an adequately trained and broadly educated personnel to enter the field of scientific research in the years ahead. The educational institutions of the country have been challenged by the events of recent years, and in the processes of self-examination the leaders of educational thought have discerned that all was not well with the educational activities of the inter-war era. It is recognized that in many respects education is at the cross-roads, and various challenging analyses of our earlier efforts have recently been issued. The new civilization that must emerge from the stress of these times will call for the education of man for freedom, for the formation of free men in free commonwealths. To secure this it will be necessary that the immense needs for technological and scientific training shall be balanced by competent education in the liberal arts and humane studies. A balance must, however, be maintained, so that science and research shall continue to attract a steady quota of the competent minds in each succeeding generation of students. Nor should their scientific orientation be unduly delayed by too great a monopoly of their earlier formative years in excessive devotion to non-scientific training. There is a general measure of agreement and a corresponding fund of good will to find a solution of this vital problem of early education in a blend of the essentials of a humanistic education with those elements of a liberal education that can best be aroused by the record of man's attainment, through the years, to his present status in science and the consequences of that achievement on the lives of us all.

The Direction of Research

The problem of direction of research is a personnel problem. It resolves itself when a competent director is found. If we think over the great centers of research in the physical sciences, whether in fundamental science or applied, do we not finally center our thoughts on the man who symbolized the laboratory? Berzelius, Arrhenius, Svedberg span a century in chemical science in Sweden; from Ostwald to Haber and Nernst runs the story of German research in physical chemistry. We think of the Cavendish laboratory in Cambridge in terms of Clerk Maxwell, Rayleigh, J. J. Thomson and Rutherford, of the Royal Institution in terms of Davy, Faraday, Dewar and Bragg. Michelson and Millikan, Richards, Compton, Lawrence, Whitney, Mees; is it not the directors who have made the research center by their own eminence in research or their own faculty of appraising the talents of others, organizing them and giving to them full scope? "I worked with X," is the formula that the young scientist will use to describe his training rather

than "I worked at Y," and in so doing he will reveal the qualities of inspiration and leadership that he had the good fortune to enjoy. He will have told of the "director" who did not direct, but drew forth from his associate the best that he could give.

There is no problem in discovering a research director when the institute grows from small beginnings around the pioneer in a new field. The speed with which the institute grows, the health of that growth, will largely lie in the capacities for direction which the pioneer himself possesses. There will be those who, in relative isolation, or at best with a few chosen colleagues, will plan their pathway into the unknown. Some researches will demand large groups of cooperating assistants, large units of expensive equipment, which will require a director who, in addition to his own scientific gifts, must needs have the power of appeal to younger colleagues and to supporting foundations or industries.

It is in the choice of a research director to take on the mantle of his predecessor in an organization that has already attained to eminence that the principal problem of research direction arises. To step into the vacant directorship is no light undertaking for any new incumbent, nor is his selection an easy responsibility for any governing board. The learned societies and the scientific academies must assume a large share in such responsibility. It is for them to realize that "the supply of competent candidates," as Dr. Buckley, of the Bell Telephone Laboratories, observes, "is lamentably low." He doubts "whether it could be successfully augmented by any systematic educational procedure. The problem is more to find than to develop those who have the necessary qualifications." Dr. Mees would apply the pragmatic test to those who are selected.

> When an institute director is making a success and producing valuable work, his field of activity should be enlarged and the institute given increased scope. When he is doing only moderately well, it is probably unwise to expand his field even though he may blame insufficient support for his inability to produce results. Good men will produce results with a minimum of means, but, as soon as they do so, the further means should be supplied.

Nor does he worry too much about the situation that may arise if the staff and even the director should be appointed for other reasons than their competence. "This difficulty will supply its own remedy. The institute will simply fail, and the advance of science, locally checked, will proceed elsewhere."

It seems reasonably certain that the selection of research directors and research professors will in the long run be most successful if the body responsible for selection consists primarily of scientific men. Breadth of interest within that body of scientists may help to promote wisdom of choice. The important chairs of science in Sweden are filled only after consultation with colleagues abroad. Within one American university at least, the nominations to a research professorship in any one science must be approved by the research committee representative of all the sciences there taught. It is also quite certain that largely non-scientific boards of control with power to formulate scientific programs for both war and peace and with power to prescribe personnel and facilities for those programs, as is true of certain proposals originating in this country from legislative sources, can not conceivably be productive of the scientific direction and potential that the country needs in either war or peace.

The Support of Research

In the field of industrial research there is no problem of support. Technological progress has revealed, in an ever-increasing measure, that research is the price of industrial development, that it can revolutionize the bases of industry, render obsolete the equipment and techniques of to-day in the new procedures of to-morrow. Facing a fight for survival by the competition which originates in the research laboratories, individual organizations and cooperating groups are deciding to insure their own financial stability and future by a large premium of research effort. There is abundant evidence that such insurance pays real dividends.

Although this is true of applied science, in basic science, from which all future applied science must inevitably stem, the financial problem of support is far from reassuring. Fundamental research is rarely directly or immediately profitable, nor can it readily be made self-supporting. Its principal assets are long-range in nature, whether from the body of workers which it produces or the new principles which it formulates from which applied science will ultimately derive the richest revenues. Faraday, formulating the principles of induction and the laws of electrolysis, is separated from the electrical age and the electrochemical industry by fifty years or more of technical incubation. Sabatier, in his humble laboratory in Toulouse, never shared in the wealth which the principles of catalysis that he laid down brought to a diversity of industries, in fat-hardening, synthetic alcohols and the petroleum industry. The discovery that the uranium atom undergoes fission processes induced by neutrons, while it makes the age of atomic energy attainable, will not secure the institutions in which such discoveries were made from future problems of support.

In large measure the support of fundamental scientific research has, in the past, been the proud privilege

of private philanthropy. Only in recent decades has any measure of support come from industry and government. This is especially true in the English-speaking world. In Germany, industry has been more closely knit to and has more handsomely supported, hitherto, the prosecution of basic science. In Soviet Russia, the great development of her modern science has been closely tied to the State, in agreement with the prevalent political ideology, both for direction and for support. What of the future?

For many reasons the outlook for support from private philanthropy is not inviting. The leveling influence of destructive warfare, the heavy taxation on incomes and inheritance which inevitably accompany such effort, all imply that institutions of fundamental research which have so richly drawn upon private fortunes in the past for their foundation and continuance face a leaner future so far as such sources of income are concerned. It will be necessary to take all measures possible to maintain such private donations in support of science at as high a level as can be achieved, since it is certain that support of such a nature is, of all support, the most desirable and the least hedged around with difficulties of administration. If the accumulations of wealth in the future, being less, imply a decrease in the size of individual fortunes and a consequent diminution in size of donations to research, ways must be found to increase the number of donations that can be secured. The broadening interest in the potentialities and effects of scientific research should result in a broadening of the bases from which private support might come. Research scientists and research directors incur in this respect a definite obligation to the areas in which their work is in progress. Civic and state contacts with successful research work should amplify civic and state support if for reasons of local pride alone. The obligations of research scientists do not end when they have achieved successfully the scientific objectives which they set themselves. That something has been lacking hitherto in scientist-donor contacts is evident from some observations of Dr. Buckley:

> It seems to me that those concerned with the support of fundamental research have not taken into adequate account the need for winning recognition and acclaim for the donor. Those who conduct researches and publish their results are commonly very much concerned with their own recognition and very desirous of public acclaim. They have been notably deficient in calling public attention to the source of funds with which the work was done. In this regard, it seems to me that not only has real injustice been done, but research workers have failed to win support which they might have won had this matter of recognition for the donor been given proper attention, particularly in the case of private donations. This is a problem not easily solved, and I think there is real need for development of a technique of recognition that treats the donor fairly and that does not result in the promotion of donations in ways which will be unfortunate.

The officers of the American Philosophical Society have frequently noted this type of blind spot in the recipient of research support. The disease should be cured if for no other reason than that fair and encouraging recognition of donors is productive of wider donor activity. Giving is contagious.

The support of fundamental research by industries is a problem of great complexity. It has been argued by some that boards of direction of industry have no right to utilize the stockholders' monies in support of scientific research, the bearing of which on the profit-making of the industry is at best arguable and at worst very remote. The legal aspects of such support have been debated on many occasions. The returns to an industrial donor are generally indirect and are normally of benefit to the donor industry and its competitors alike. Industries of great breadth of activity with highly developed industrial research organizations of their own can most easily accommodate themselves to these factors in industrial support of basic research, and seize swiftly for their own advantage the results that accrue from such support. Taking the long-range view and admitting that immediate profits from new discoveries are rare, we must concede that industry does receive benefit from fundamental research in at least two important directions. The supply of adequately trained research workers inevitably increases in centers of intense research activity. The new discovery is as luring as gold in the Yukon Territory. Further, the broadening of understanding that accompanies each new scientific discovery means for the industrial research laboratory a surer, swifter and more economical approach to its own objectives. The history of synthetic toluene is instructive in this regard. In both World Wars I and II the need for toluene far exceeded the peace-time production from coal-tar sources. As early as 1916, in World War I, the possibility of producing toluene from petroleum source materials was realized. But expenditures running into millions of dollars did not solve the industrial problem at that time. Two decades of research in the basic aspects and principles of catalysis were needed to indicate in what direction the program, which led to failure in 1914–1918, could surely and swiftly be brought to a simple technical solution. There are many examples which could be cited of the auto-accelerating effects of basic scientific discoveries on the objectives of industrial research. Large industries have already decided, and will in increasing measure in the future decide, to support fundamental research.

What of the decentralized industries that operate

in small, widely distributed units with only a relatively small number capable of maintaining research laboratories for their industrial problems? What measure of support for pure science can they supply? How can they meet the competition from without, to which large industrial research organizations by the breadth of their own research efforts subject the little industry? The answer would seem to lie in a cooperative effort shared in limited amount by each but, in aggregate, large and impressive. It would seem to lie in the development of the research institute, whose main objectives should be (1) the prosecution of fundamental studies in the general field of the pertinent subject, its physics, chemistry, biological and engineering aspects, (2) the dissemination of research information covering scientific and economic aspects of the field, and (3) the training in the methods of research of specially selected personnel at the graduate student level for future positions of responsibility within the industry. Coordinated with an existing educational foundation, such a research institute could produce mutual advantages for both. Each would enlarge its own research horizons, each could supplement the others' activities with personnel and facilities. The advent of the cooperative research institute in the educational centers of the land can be made of significant importance in the general problem of support for research.

State and Government support of fundamental research is at once the most obvious and at the same time the most hazardous of all the forms of support. By its nature it recognizes that the endowment of research is the concern of all citizens alike and all should share in its burdens and its benefits. Such support tends, at the same time, to enmesh the laboratory with the hurly-burly of competing ideologies or conflicting interests that hamper even the most liberal forms of government and, in the worst cases, tend to destroy that independence of scientific opinion, that autonomy of science, without which it can not fulfill its proper functions to society. We are too near to recent efforts to break the autonomy of scientific effort, to subordinate it to State ideologies and totalitarian control, to be unmindful of its real dangers. We must not forget that even democratic legislative bodies have attempted to define $\pi = 3$, in the supposed interests of their growing youth. Can we hope, in these democratic forms of government, for that larger measure of political wisdom that is prepared to surrender to competent scientific bodies, such as the National Academy of Sciences, the problem of disposition of community support to scientific sections of the universities and research foundations, freeing it thus from every vestige of political or ideological control? The history of the relations between the United States Government and the National Academy of Sciences in the past does not augur well for future improvement in this regard. May we not hope, however, that the lessons of these harsh years, in which scientifically trained university presidents, executive officers of scientific and research foundations, professors of science, have crowded the offices of government departments in striking contrast to the days of peace, may we not hope that those lessons will show that the peace can be lost, has in the past been lost, because of neglect or oversight of the major role that scientific discovery, no less than applied science, plays in those days of peace? May we not hope for the realization that, no less in peace than in war, local, state, national and international relations, social and political affairs, have become inseparable from the discoveries of the scientist in his laboratory and their manifold applications? And, realizing this, may we not hope for that measure of disinterested financial support which shall best promote that scientific harvest? To secure this with maximum efficiency and least impedance it seems necessary that the scientists shall be masters in their own households.

But, masters in their own households, there still lies upon them the paramount necessity of integrating their skills and their findings with the broad stream of life which flows outside the laboratories. To go forward to meet the years of difficulty ahead, we shall need the effort of all men of good will, among whom the scientist, by the nature of his calling, must certainly be numbered. The processes of mutual cooperation and assistance among the individual sciences must be multiplied. The isolation of one science from another must become progressively less and less, even though the degree of specialization within a science becomes perhaps greater and greater. This calls for an increasing breadth of culture and of education among the scientists, an increasing dedication by the noblest minds to the forward march of knowledge; but it calls also for a fuller appreciation of the social consequences of that knowledge, a franker recognition of the other factors contributory to true knowledge, to wisdom. "The modern world," says Maritain, "by which I mean that world which is coming to an end before our eyes, has not been a world of harmony between forms of wisdom, but one of conflict between wisdom and the sciences, and," he adds, "it has seen the victory of science over wisdom." Have not we scientists, so to speak, to surrender that victory? We shall not yield our energy, our courage, our diligence in search of truth. We shall but renounce the primacy to which a sick world has thrust us; and we shall gain by our renunciation. In the free world to which we

still dare to look forward, with the soldiers and statesmen, artists, humanists, philosophers and priests, we must integrate our scientific skills with the social and spiritual aspects of human life and nature. That goal attained, we shall not lack either direction or support for the physical sciences.

OBITUARY

EDWARD OSCAR ULRICH

EDWARD O. ULRICH was the last survivor of the five great invertebrate paleontologists who were the dominating figures in Paleozoic work in 1900. Charles E. Beecher died forty years ago. John M. Clarke, Charles D. Walcott and Charles Schuchert fortunately survived much longer, and, with Ulrich, were universally considered the leaders in the field so long as they lived. These four paired admirably: Walcott and Clarke, suave, diplomatic, executive; Ulrich and Schuchert, blunt, outspoken, indefatigable workers, zealous for detail. Each was a man of strong personality. They were at times great friends, at others great foes. But all of them were seeking scientific truths. The writer came to know all of them, and the thing which stands out best in his memory is that, however much we differed on scientific matters, we were always good friends.

Ulrich was a delightful personal companion, equally eager to argue or joke. But he was always good-natured. I never knew him to express anger, no matter what he might feel.

But this is neither a biography nor an appreciation. Since I heard of his death, I have been trying to appraise his position in the field of invertebrate paleontology. It seems to me that he was the greatest descriptive paleontologist that America has ever produced. He had a remarkable eye for form and a genius for detail. His memory was extraordinary. It is doubtful if he forgot the details of any species he ever studied. In contrast to much of the rather hasty work of some of his contemporaries, his descriptions have stood the test of time. His skill as an artist and lithographer was probably the basis of his success. After the publication of his work for the Illinois and Minnesota State Surveys he was accused of making far too many species, the innuendo being that he was paid for his labor at so much per new species. Later workers have shown that his species were good, and that he could have made many more if he had had access to more and better material. His work is the foundation for later studies on Paleozoic Bryozoa, Ostracoda and Conodonts, Ordovician Gastropoda and Pelecypoda. He also contributed much to knowledge of Cambrian and Ordovician trilobites and Mississippian pentremites.

During his long life, Ulrich probably saw more of the Paleozoic formations of the eastern half of the United States than any other man. His contributions to stratigraphy and correlation were voluminous, not only in what he himself published, but in the aid which he gave to other geologists during the many years of his association with the U. S. Geological Survey. Some one else will have to appraise this side of his work, for his ideas were so diametrically opposed to those of the present writer that he can offer no judgment. But he made a great contribution in this field, for he provoked—and I really mean provoked—many geologists to make much more careful studies than would otherwise have been done. His discussions furnished food for thought, and much good came of them.

Edward Oscar Ulrich was born in Cincinnati on February 1, 1857, and died in Washington on February 22, 1944. He was a member of many learned societies, and a great contributor to knowledge in his field. His was a useful life, well lived. If it had not been for him, we should have had no Schuchert in geology, and there are many others who owe their start to him.

PERCY E. RAYMOND

MUSEUM OF COMPARATIVE ZOOLOGY,
CAMBRIDGE, MASS.

DEATHS AND MEMORIALS

DR. HARRIS HANCOCK, who retired with the title emeritus in 1937 as professor of mathematics at the University of Cincinnati, died on March 19. He was seventy-seven years old.

DR. BENJAMIN MILLER, since 1907 head of the department of geology of Lehigh University, died on March 23. He was in his seventieth year.

DR. CARL KOLLER, consulting ophthalmic surgeon at the Mt. Sinai and Montefiore Hospitals, New York City, died on March 21 at the age of eighty-six years.

AT the graduating exercises of Lafayette College on March 26 a memorial address was made by Dr. B. W. Kunkel, professor of zoology, on "The Life of Dr. J. McKeen Cattell," who graduated from Lafayette College in 1880.

SCIENTIFIC EVENTS

THE FACULTY OF SCIENCE OF THE UNIVERSITY OF ANKARA

Nature gives an account of the opening, in the presence of President Inönü, on November 8, 1943, of a new Faculty of Science in the University of Ankara. The president, accompanied by the Prime Minister, Sükrü Saracoglu, was welcomed at the inauguration ceremony by the chairman of the National Assembly, B. B. Abdülhalik Renda. All the members of the Cabinet were present; R. F. Lucas, of the British Council, was also invited to attend the ceremony.

The Minister of Education, Hasan Ali Yücel, in his opening address, referred to Turkish progress during the twenty years since the establishment of the Republic. The consequent changes in the national outlook have developed a need for scientific and technical training which is now enhanced by the mechanization of armed forces in a world at war. Hitherto Turkish educational institutions have lacked equipment for practical training; but Turkey has now an established policy of education based on positive knowledge to reinforce the earlier practice of theoretical training only. The nation needs mechanical engineers, mining and civil engineers, and the great problem of Turkey to-day is to find the means for training students in large enough numbers to satisfy the national requirements without reducing the educational standard. The Government is keenly aware of these needs and has sanctioned the establishment of this faculty as a step to meet them. The assembly was later addressed by the rector of the faculty, by a student and by Professor Kerim Erin, of the Faculty of Science, University of Istanbul.

The new faculty is temporarily installed in the Gazi Teachers' Training Institute. The dean of the faculty, Bay Hayri Doner, is also professor of physics and a member of the Board of Education. The chair of chemistry and the presidency of the new Chemistry Institute of the faculty is held by Dr. Avni Refik Bekman. The Ministry of Education has invited the British Council to nominate British candidates for a professorship in each of the existing departments of chemistry, physics and mathematics. The establishment of this faculty thus implements the approval of the bill recently presented by the Turkish Cabinet to the Chamber of Deputies.

THE MAY CONVENTION OF THE SOCIETY OF AMERICAN BACTERIOLOGISTS

THE Society of American Bacteriologists will convene in New York City at the Hotel Pennsylvania on May 3, 4 and 5 for the first time since December, 1941. The 1942 convention, scheduled for Columbus, Ohio, was cancelled by the society at the request of the Office of Defense Transportation and no attempt was made to plan a meeting during 1943. The present officers of the society include: *President,* I. L. Baldwin, University of Wisconsin; *Past-president,* Rebecca C. Lancefield, Rockefeller Institute; *Vice-president,* Stuart Mudd, University of Pennsylvania; *Secretary-Treasurer,* W. C. Frazier, University of Wisconsin, and *Councilors-at-Large,* Martin Frobisher, Jr., the Johns Hopkins University; W. J. Nungester, the University of Michigan; N. Paul Hudson, the Ohio State University, and L. S. McClung, Indiana University.

The program will feature wartime topics and recent research in bacteriology and will include: "Recent Advances in Our Knowledge of the Physiology of Microorganisms," C. B. van Niel; "Electron Microscopy in the Field of Bacteriology," V. K. Zworykin, James Hillier and Perry C. Smith; "Antibiotic Activity as Viewed by a Mycologist," Charles Thom; "Mode of Action of Antibiotic Substances," Selman A. Waksman; "Standardization of Assay of Penicillin," Albert C. Hunter; and "An Analysis of the Therapeutic Action of Penicillin Based on the Clinical Response of Patients and Correlated Laboratory Findings," W. S. Tillett; a series of six papers in a general symposium on "Rickettsial Diseases"; a series of six papers prepared for the committee on teaching; round-table discussions on (a) "Taxonomy," A. P. Hitchens, convener; (b) "Atypical Pneumonia," Frank L. Horsfall, Jr., convener; (c) "Anaerobic Bacteria," Ivan C. Hall, convener; (d) "Airborne Infections," Alexander Hollaender, convener, and (e) "History of Bacteriology in New York City," Augustus B. Wadsworth, convener; showing of programs of films by the committee on visual instruction in microbiology, and an exhibit of a new console model of the electron microscope by the Radio Corporation of America.

In addition to the above, the program will include approximately 130 other papers on various topics as well as 25 or more exhibits by sustaining members, committees or members of the society. The Eli Lilly Award of $1,000 and a medallion will be presented to a young bacteriologist in recognition of outstanding research accomplishment. The name of the recipient will not be announced until the annual dinner. The program will open at 10:00 A.M. on May 3. All sessions will be held in the Hotel Pennsylvania. Consistent with wartime conditions, all entertainment features have been eliminated from the program except the president's reception and dinner.

Members of the society will receive copies of the program from the secretary-treasurer; others may obtain information concerning the program from the chairman of the program committee, Dr. L. S. McClung, Indiana University, Bloomington.

THE PENNSYLVANIA ACADEMY OF SCIENCE

THE twentieth annual meeting of the Pennsylvania Academy of Science will open at York on Friday

afternoon, April 7, at two o'clock, under the presidency of Dr. Clarence A. Horn, of Albright College.

At the afternoon session, the address of welcome will be given by Dr. Arthur W. Ferguson, superintendent of schools of York. A program of scientific papers will be presented by members.

On Saturday there will be a "Symposium on Burns." This is expected to attract many teachers, first aid and medical people, as well as other members of the general public.

On Friday evening, Dr. Edgar T. Wherry, professor of botany at the University of Pennsylvania, will speak on the wild flowers and ferns of the lower Susquehanna Valley, an area particularly rich in rare rock ferns. His address will be illustrated with colored slides.

With the awarding of the Academy Research Grant at the coming York meeting, $1,000 will have been provided by the American Association for the Advancement of Science to carry on scientific investigations in Pennsylvania. Since 1935, the association has made available to the academy annually a sum of fifty cents for each member who is enrolled in the association. This has averaged $100. A standing committee on grants passes on all applications and administers the fund.

All meetings will be held in the William Penn Senior High School. The public is invited to attend.

THE DRAFTING OF SCIENTIFIC WORKERS

Dr. Charles L. Parsons, secretary of the American Chemical Society, following a conference in Washington, called by the society, has made public a statement protesting against the indiscriminate drafting of chemists, chemical engineers and other technically trained professional workers between the ages of eighteen to twenty-six.

The chairman of the committee that prepared the statement, approved by the representatives of the eighty-two companies participating in the conference, was L. B. Morris, director of personnel contact relations, Radio Corporation of America, Victor Division. Other members were E. T. Asplundh, vice-president, Columbia Chemicals Division, Pittsburgh Plate Glass Company; M. T. Carpenter, associate director of research, Standard Oil Company of Indiana; J. N. Forker, vice-president, Koppers Company, and E. P. Wechesser, administrator of Selective Service, B. F. Goodrich Company. The statement reads in part:

It is the duty of this conference to bring to the attention of the President of the United States, as Commander-in-Chief of the Armed Forces, and of his principal military and production advisers, the facts governing a situation which can only be regarded as critical and as a direct threat to the successful prosecution of the war.

Both our enemies and our allies are deferring technically trained [illegible] their manpower. It is urgently recommended that action be taken immediately to assure the deferment of non-replaceable employees in critical occupations in essential industries, regardless of age or marital status.

It is further pointed out that

There has never been a surplus of chemists and chemical engineers in the United States; the need for such technically trained men has always been greater than the supply; the unprecedented demand for industrial chemicals, synthetic rubber, aviation gasoline, foods and drugs, including penicillin, blood plasma, anti-malarials and the sulfanilamides, has thrust upon the chemical and allied industries a responsibility which can be met only if trained personnel is available to direct research and manufacturing operations.

If scientifically trained men are drafted in large numbers, production will suffer because the efforts of thousands of workers in war plants will deteriorate owing to the lack of proper supervision.

Dr. Parsons addressed a letter to President Roosevelt on March 14 in which he said that at the meeting of a hundred and twenty-five members of the American Chemical Society on the previous day it was agreed that war production "faced disaster if chemists, chemical engineers, physicists and certain other scientists were estopped from using their specific training in this war."

Mr. Roosevelt replied as follows:

I have your letter of March 14 on behalf of the American Chemical Society. As you know, there is great demand for men under twenty-six for combat duty overseas. In order to meet that demand it may be necessary to dip into the pool of man power now being used for war production, government and agriculture. In every case there will have to be a determination as to where each man can render the best service.

I agree that where young men possess special skill, training and qualifications in chemistry, chemical engineering, physics or other scientific fields it would deter the conduct of the war to take them from their scientific work. This is particularly true of new scientific developments in which younger men have probably received better training than the older scientists.

I thank you for writing, and desire to assure you that the special need for such men in scientific work in industry will be kept in mind as we proceed to draw more and more younger men into the armed services.

The National Roster of Scientific and Specialized Personnel, which lists for war purposes scientific and technical workers, has not immediately available a count of men under twenty-six years. Those of 29 years and under as of July 1, 1943, as reported by Science Service are as follows: Aeronautical engineering, total 5,348—2,732 or 50 per cent.; chemical engineering, 14,115—9,049 or 64 per cent.; radio engineering, 5,589—1,748 or 32 per cent.; physics, 10,004—3,464 or 35 per cent.; chemistry, 65,410—28,332 or

cent.; mechanical engineering, 24,651—7,008 or 28 per cent.; electrical engineering, 20,818—4,595 or 22 per cent.

THE WORCESTER FOUNDATION FOR EXPERIMENTAL BIOLOGY

The Worcester Foundation for Experimental Biology, at Clark University, has recently been incorporated. The purpose of this organization is "to carry on investigations in the biological sciences, including the medical sciences." Professor Harlow Shapley, director of the Harvard Astronomical Observatory, is the president of its board of eleven trustees. Others on the board are Dr. R. G. Hoskins, director of the Memorial Foundation for Neuroendocrine Research; Dr. W. J. Crozier, professor of general physiology at Harvard University, and Dr. William Malamud, clinical director of the Worcester State Hospital and professor of psychiatry at Tufts College. Professor Hudson Hoagland, on war leave from his work at Clark University, is executive director of the foundation, and Dr. Gregory Pincus, visiting professor at Clark University, is director of laboratories. Researches sponsored by the foundation are being carried out by some dozen investigators.

The foundation is primarily interested in the general physiology and biochemistry of the hormones and respiratory enzymes and their possible interrelations. It is also concerned with applications of such work to studies of psychomotor fatigue, particularly in industry, and to neuropsychiatric problems. Extensive clinical facilities for the latter work are available at the Worcester State Hospital, where the research staff, including members of the Memorial Foundation for Neuroendocrine Research, are cooperating closely with the work of the foundation.

THE NAPLES ZOOLOGICAL STATION

Some time ago the National Research Council received information that the Naples Zoological Station was physically intact and its staff still on the ground, with Dr. G. Montalenti as acting director. The following additional information has now been received: The aquarium is now open to Allied officers and soldiers on the payment of an admission fee. The Military Services have assisted the aquarium in its publicity and the promotion of visits by groups of soldiers.

Certain funds have been made available to the aquarium to replace the former state and city subsidies.

The Royal Society of London also has made a grant of £1,000 to the station for its 1944 program of research.

The Army has been assured by the acting director that with the above-mentioned assistance the aquarium and zoological station can now carry on an active program of research in which certain professors of the University of Naples and their students are participating.

Ross G. Harrison

SCIENTIFIC NOTES AND NEWS

The Eli Lilly and Company Prize of $1,000 for 1944 will be presented on April 5 at the one hundred and seventh meeting of the American Chemical Society at Cleveland to Dr. Joseph Stewart Fruton, of the Rockefeller Institute for Medical Research, New York, in recognition of his "fundamental studies on the isolation, purification, mode of action and specificity of proteolytic enzymes of both plant and animal origin. The use of synthetic peptides as a tool in studying the specificity of enzymes was developed to a high degree and has afforded a new insight into the role of enzymes in the hydrolysis and synthesis of proteins."

At the same meeting the Borden Company Prize for 1944 of $1,000 for research in the chemistry of milk will be presented to Dr. William Mansfield Clark, DeLamar professor of physiological chemistry at the Johns Hopkins University and chairman of the Division of Chemistry and Chemical Technology of the National Research Council, for his contributions to the application of acid-base theory to laboratory and plant practice. "As a result of his work and writings," according to the citation, "the old haphazard and often irrational procedures in the dairy industry and other industries have been fruitfully transformed during the past years to precise scientific manipulations."

Officers of the Ecological Society of America have been elected for 1944 as follows: *President,* Robert F. Griggs, National Research Council; *Vice-president,* Alfred C. Redfield, Oceanographic Institution, Woods Hole; *Treasurer,* H. J. Oosting, Duke University; *Executive Committee Member,* J. M. Aikman, Iowa State College; *Editorial Board Ecology*—for Botany, Paul B. Sears, Oberlin College, and Hardy L. Shirley, Allegheny Forest Experimental Station; for Zoology, P. L. Errington, the Iowa State College; and G. E. Hutchinson, Yale University; *Editorial Board Ecological Monographs*—for Botany, F. W. Albertson, Kansas State College; for Zoology, H. E. Ewing, National Museum and U. S. Department of Agriculture; *Representative, Union of American Biological Societies,* Robert E. Coker, University of North Carolina; *Representative, National Research Council,* H. A. Gleason, New York Botanical Garden; *Chairman,*

Committee on Preservation of Natural Conditions, Curtis L. Newcombe.

At the forty-ninth meeting of the Michigan Academy of Science, Arts and Letters, held in Ann Arbor on March 17 and 18, the following officers were elected: *President*, Alfred L. Nelson, chairman of the department of mathematics, Wayne University; *Vice-president*, Harry D. Ruhl, head of the Game Division of the Michigan State Department of Conservation; *Secretary*, Frederick K. Sparrow, Jr., of the department of botany of the University of Michigan; *Treasurer*, Mischa Titiev, of the department of anthropology; *Librarian*, Warner G. Rice, director of the library, and *Editor*, Henry van der Schalie, of the University Museums.

Dr. Henry C. Fixott, of Portland, Ore., has been elected president of the American College of Dentists.

New appointments to the medical faculty of Columbia University include Dr. Edgar M. Medlar, director of the Hegeman Memorial Research Laboratory, New York, as associate professor of pathology, and Dr. Samuel Gelfan, director of research of the Van Patten Pharmaceutical Company, Chicago, as assistant professor of physiology.

Dr. John D. Lyttle, of the department of pediatrics of the College of Physicians and Surgeons of Columbia University, has been appointed professor of pediatrics in the School of Medicine of the University of Southern California and director of pediatrics at the Los Angeles Children's Hospital.

Dr. Frank E. Egler, of the department of physics of Syracuse University and the department of botany of the New York State College of Forestry, has been appointed associate professor of physics at Knox College. He will maintain his connection with the Chicle Development Company.

Dr. Thomas Parran, of New York, has been nominated by President Roosevelt to be Surgeon General of the U. S. Public Health Service for another term of four years.

At a recent meeting of the Executive Committee of the Board of Directors of the Long Island Biological Association, Professor Harlow Shapley, director of the Harvard Observatory, was elected a member of the board. Dr. Berwind P. Kaufmann, of the Carnegie Institution, Cold Spring Harbor, New York, was elected assistant secretary of the association and will carry on the work of the office of secretary, left vacant by the death of Dr. Chas. B. Davenport, until this office is again filled.

Austin F. Hawes, since 1921 forester of the State of Connecticut, retired on January 30. William C. Shepard has been the acting state forester during February and March. Dr. Raymond Kienholz, of the department of forestry of Connecticut College at New London, becomes state forester on April 1.

Dr. James A. Crabtree, executive assistant to the Surgeon General of the U. S. Public Health Service, who since April 1, 1943, has served as chief medical officer of the Office of Foreign Relations Administration, has been appointed acting chief of the health division of the United Nations Relief and Rehabilitation Administration.

Dr. David Sarnoff, president of the Radio Corporation of America, has been called to active duty as a colonel in the Army Signal Corps. In his absence Major General James G. Harbord, U.S.A., retired, chairman of the board, will take over the active management of the company.

Grants-in-aid for research for the year 1944–45 have been made by the American College of Dentists to Dr. B. Gottlieb, of the College of Dentistry of Baylor University, Dallas, $300 for a histological study of dental caries; to Wendell L. Wylie, of the Dental School of the University of California, $500 for a study of the dental conditions of monozygotic twins, and to Dr. H. R. Hunt and Dr. C. A. Hoppert, of Michigan State College, East Lansing, $500 for the continuation of a study of inheritance in rat caries.

At the College of Medicine of Wayne University studies on protein metabolism will be carried out under the supervision of Dr. John W. Hirshfeld, assistant professor of surgery, and Dr. Arthur H. Smith, professor of physiological chemistry. The project will be financed through the Office of Scientific Research and Development. The department of physiological chemistry of the College of Medicine has received a grant of $900 from the Gerber Products Company to be used in the study of cereal-milk products.

The report for 1943 of the Rockefeller Foundation states that Dr. Charles N. Leach, of the Far Eastern field staff of the International Health Division, and C. G. Copley, of the Manila office of the foundation, returned to America last December on the exchange ship *Gripsholm*. Both had been interned since the fall of Manila. At that time, the Japanese looted the office of the foundation and destroyed all records. In China, Dr. Henry S. Houghton, director of the Peiping Union Medical College, and Trevor Bowen, its comptroller, are still imprisoned, and hope for their early return seems slight. The buildings of the college have been taken over by the military and the greater part of their contents has been removed.

Dr. Bruce L. Clark, associate professor of paleontology and curator of the Museum of Paleontology of the University of California at Berkeley, is leaving for Mexico to make a study of Tertiary fossils. He

has completed a monograph on the Eocene faunas of South America and hopes to obtain specimens that will enable him to establish more accurately the correlations between North and South America.

DR. ANDREW TOPPING, deputy medical officer of health of the London County Council, has been appointed chief medical officer to the United Nations Relief and Rehabilitation Administration.

IT is reported in *Nature* that the British Medical Research Council has established a unit for research in human nutrition as part of its staff organization, and that Dr. B. S. Platt has been appointed its director. Temporary accommodation has been provided at the National Hospital for Nervous Diseases, Queen Square, London. Some part of the investigations undertaken by the unit will be directed toward nutrition problems in the tropics. Among other things, Dr. Platt will continue the work, for which he joined the staff of the council in 1938, of coordinating a program of nutritional investigations in the Colonies by arrangement between the Colonial Office and the council.

PROFESSOR HENRY A. MATTILL, director of the department of biochemistry at the University of Iowa, gave the annual Day Lecture before the Chapter of Sigma Xi of the University of Rochester on February 22. His subject was "The Long and Short of Nutrition."

AT the request of the Coordinator of Inter-American Affairs, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Paraguay and Peru have sent sixteen representatives to the University of California at Berkeley for a special course to be given by the new School of Public Health. There will be two terms of sixteen weeks covering problems of nutrition and personal hygiene; sanitary bacteriology and environmental sanitation; general education and sociology; public health administration, and health education. The teaching staff will include members of the School of Education and of the department of home economics and social welfare; the School of Medicine at San Francisco; and representatives of the U. S. Public Health Service, the Children's Bureau of the Department of Labor and the State Department of Public Health.

AN appropriation amounting to $135,732 for grants-in-aid for research has been made to the University of Wisconsin by the Alumni Research Foundation.

THE Medical Branch at Galveston of the University of Texas has received grants of $2,400 each for the support of fellowships in pharmacology from Frederick Stearns and Company of Detroit and from the Bilhuber-Knoll Company of Orange, N. J.

IT is stated in *The Museum News* that Eagle's Nest, the home of the late William K. Vanderbilt, Jr., at Huntington, Long Island, is to become a public museum and park. The will, filed in January, provides that the Vanderbilt Marine Museum, which was built on the grounds by Commodore Vanderbilt in 1922, the mansion with certain furnishings and the land shall become public property upon the death of Mrs. Vanderbilt or after she may cease to occupy the home. Administration will be by three trustees who are to offer the property first to New York State or then to the county or finally to the town of Huntington. If the gift is not accepted, the trustees after two years are to create an organization to control the museum and park. The will provides for a trust fund of $2,000,000 of which the income will be for operation and maintenance. Eventually this fund will be substantially increased from the residuary estate, the value of which has not yet been determined.

APPLICATION has been filed with the Federal Communications Commission for a unique type of FM broadcasting station for the Washington, D. C., area. The applications was filed in the name of the FM Development Foundation, organized by Professor Edwin H. Armstrong, of Columbia University, inventor of the FM system, and by C. M. Jansky, Jr., and Stuart L. Bailey, members of the Washington consulting engineering firm of Jansky & Bailey, who constructed the first FM station there. The proposed site of the station is at Olney, Md., and the transmitting equipment will be substantially a duplicate of Professor Armstrong's station at Alpine, N. J. The foundation is organized to carry on research to foster the development of the FM broadcasting art.

DISCUSSION

INSTIGATOR OF THE WEATHER BUREAU

THE issue of SCIENCE for December 24, 1943, in the biographical sketches contributed by Everett I. Yowell errs in crediting Cleveland Abbe with initiating "a system of daily weather reports and storm predictions which led to the establishment of the United States Weather Bureau" (page 553), and the tablet at the Abbe Meteorological Observatory in Cincinnati is wrong in calling him the "First official United States Weather Forecaster" (page 555). Instead, the credit for these achievements should go to Increase A. Lapham (1811–75) of Wisconsin.

On December 8, 1869, Lapham petitioned Congress to inaugurate a system of forecasts, reciting the losses of men and ships in storms on the Great Lakes and the success of the French weather service which organized a telegraphic weather service with maps in 1855 (Cong. Doc. Ser. No. 1431, Doc. 10). The bill requested by Lapham was introduced by Congressman H. E. Paine of the First Wisconsin (Milwaukee) District on December 14, 1869, and became law on February 9, 1870 (16 Stat. 369).

The Wisconsin Historical Society possesses a holographic letter from Abbe to Lapham dated January 7, 1870, acknowledging Lapham's authorship of the legislation in the words, "I must express the pleasure experienced in realizing the energy with which you are pushing the matter of a telegraphic meteorological system of storm warnings."

The society also has the holographic commission appointing Lapham assistant to the chief signal officer of the United States on November 8, 1870, signed by the chief signal officer, Albert J. Myer. According to the Annual Report of the Chief Signal Officer for 1871, Lapham had "supervision of the signal service on the lakes" (page 7), and Lapham's report in the same volume (page 167) shows that he issued a storm warning on the day of his appointment and continued making weather maps for forecasts until the end of the season of navigation.

The appointment of Abbe to a similar position at Washington took place on January 3, 1871 (*ibid.*, page 8) and he began forecasting on February 19, 1871, 103 days after Lapham.

It is also interesting to note that this society has two weather maps issued by Abbe for the Cincinnati Board of Trade and similar to those issued by the Western Union Telegraph Company at Cincinnati in continuation of Abbe's maps (see W. H. Alexander, "A Climatological History of Ohio," Columbus, 1923, pages 24–25). None of these maps contains isobars, forecasts or other "analysis." Only data of temperature and wind direction are given.

For a fuller account of Lapham and his contributions, reference is made to Eric R. Miller, "New Light on the Beginnings of the Weather Bureau from the Papers of Increase A. Lapham," *Monthly Weather Review*, February, 1931.

EDWARD P. ALEXANDER,
Director

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A RELATIONSHIP BETWEEN DENTAL CARIES AND SALIVA

A CLEAR relationship has been discovered between the rate of starch hydrolysis by saliva and the incidence of caries in the individual. Without exception among those studied, individuals with extensive caries (twenty or more cavities) produce saliva which hydrolyzes starch under standard test conditions with extreme rapidity. Individuals without caries produce saliva which hydrolyzes starch very slowly.

In 51 careful case studies at the Forsyth Dental Infirmary and at Radcliffe College no one has been found whose salivary reaction is out of line. Table 1 reflects the data accumulated to date:

TABLE 1

Number of individuals	Number of cavities	Average time
4	0	44.5 min.
6	1 to 3	36.5 "
8	4 to 6	18.5 "
14	7 to 9	8.7 "
13	10 to 12	6.8 "
2	13 or 14	4.0 "
2	20 or 21	1.8 "
2	32 or 33	1.0 "

A more detailed report upon this investigation is in preparation and will appear later with speculations on fluoride and amino acid in relation to the caries problem.

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THE USE OF RHODIUM IN BLOOD CHEMISTRY

A YEAR ago I noticed the symbol "Rh" used in a biochemical abstract. Working on the "Bibliography of the Metals of the Platinum Group," I wondered about the use of rhodium in blood chemistry, and following it up I received the following from Dr. Levine: "Although I agree with you in general, it is nevertheless difficult to assign names to substances of biological activity which are not duplicated in another branch. There are a number of agglutinable factors identified by the letters A, B, O, M, N and P. We couldn't use the letter R because this was previously used instead of O. The letters Rh seemed indicated, since it followed the alphabetical arrangement of other blood factors and at the same time shows its relationship to a blood factor in macacus rhesus."

As it seemed probable that this symbol would be used only in biochemical publications, there would be little probability of any confusion, but *Science News Letter* for November 27 has a half page article on a "New Blood Test," in which "Rh" occurs more than a dozen times, in such expressions as "Rh factor," "Rh blood" and even "Rh husbands." As "Rh" has been used as the symbol for the metal rhodium for more than a century, and has at least been seen by every

student of chemistry, it would seem better to give the Rhesus monkey's blood factor some other symbol. After reading the article in question some sufferers from "conjugal childlessness," with knowledge of chemistry but not biochemistry, might hope to effect a cure by injections of colloidal rhodium.

JAS. LEWIS HOWE
WASHINGTON AND LEE UNIVERSITY

AN INTERESTING REFERENCE TO LENGTH OF DAY AS AFFECTING PLANTS

DR. S. F. BLAKE, of the U. S. Department of Agriculture, has called my attention to an interesting reference in which length of day is considered a factor affecting the distribution of plants.

Arthur Henfrey, in his book "The Vegetation of Europe," published in 1852, discusses the flora of the British Islands in relation to the flora of Continental Europe. On page 169, he discusses the ranges of different groups as affected by various factors of climate, including maritime and continental influences.

It is interesting that he recognizes one portion of British plant life as apparently dependent upon length of day or the amount of direct sunlight, rather than upon mean temperature or other conditions of the climatic complex. Such plants, he theorizes, are circumscribed by lines which coincide with the parallels of latitude.

It is apparent in this theorem, which he had amplified no farther by discussion or experimental data, that Henfrey plainly saw the implications of length of day in the natural distribution of plants. His ideas, however, appear to have gotten no farther than the stage of philosophical statement. It was not until 1920, about sixty-eight years later, that our present experimental knowledge of length of day began.

H. A. ALLARD
U. S. DEPARTMENT OF AGRICULTURE

SCIENTIFIC BOOKS

BELOVED SCIENTIST: ELIHU THOMSON

Beloved Scientist: Elihu Thomson, a Guiding Spirit of the Electrical Age. By DAVID O. WOODBURY. With a foreword by OWEN D. YOUNG. xiii + 358 pp. 16 plates. Whittlesey House, McGraw-Hill Book Co., 1944. $3.50.

A REALLY good and lovely biography is a much rarer thing than a good and lovely life, so much richer is nature than man's art. Here is an extraordinarily good biography of one of the less widely popularized, but very potent figures in that generation of adventurers, discoverers and inventors who brought on what we call "the electrical age."

The subject of this book has all the marks of a Horatio Alger hero, but with the additional realism of association with many other such heroes who were his predecessors or competitors in the electrical age. By what amounts almost to a stroke of genius this biography is entitled "Beloved Scientist," for it characterizes so perfectly the amiable personal qualities which distinguished Elihu Thomson from many other inventors of his period and which greatly endeared him to all who knew him.

This book contains a most interesting account of the principal inventors of the "Electrical Age." It is much more than a biography of one person, for it is really a history of the electrical industry and its founders. Here one finds intimate and yet full-length word portraits of Edison, Brush, Westinghouse, Steinmetz, Pupin, Lempe, Van Depole, Maxwell, Kelvin, Tyndall, Gramme, Helmholtz, Crooks, Hertz, Roentgen, Silvanus Thompson and Marconi. The book is full of sketches of significant and yet little known events in the lives and labors of many of these men.

So far as Elihu Thomson is concerned he fits into this assemblage as one of the most interesting and inspiring of them all. His youthful precocity, his years of laboratory experiments in his own home, his high-school career as student and later as teacher and professor and finally his great career as inventor are described in a most interesting manner. His interest is shown not merely in electricity but in almost everything that he observed in nature or art. His curiosity regarding the causes of things was universal; for example, he made experiments to find out how laughing gas produces anesthesia and concluded that it was due to the absence of oxygen necessary for cerebral activity. He had little faith in the ordinary practitioner of medicine and always insisted on knowing why certain prescriptions were given—usually without getting a satisfactory answer, which then stirred him up to make experiments of his own.

While he was still in the Central High School of Philadelphia he was greatly interested in photography and in making lenses for microscopes and telescopes. He also began experiments on what we would now call a telephone. After he had joined the teaching staff at the high school his experiments extended to everything in connection with electric energy and its utilization. One extraordinary experiment of his has been commemorated at the Benjamin Franklin High School by a tablet which states, "This is the birthplace of wireless, 1875"; for there he found that electric waves were transmitted through the air and through

brick walls to a distance of about 100 feet. In 1875 a fundamental invention of his was the three-coil dynamo; another was the electrical magnetic regulator. The Centennial Exposition of 1876 gave him such a stimulus with respect to electric lighting that it led to a large number of his inventions in that field.

Thomson's discoveries and inventions during his high-school career were made in conjunction with Professor Edwin J. Houston, who generally claimed the major credit for his minor part of the work. In 1880 Thomson decided to leave the profession of teaching and to devote himself to a career as inventor. He accepted a call to organize the American Electrical Company at New Britain, Conn., and accompanied by one of his high-school seniors, E. W. Rice, he removed to that place. Amidst great difficulties there he carried out a series of remarkable experiments leading to several important inventions, among them the lightning arrestor and electrical welding. This was a period of breathless haste in patenting inventions. Among the leaders in this race were Edison, Thomson, Brush and Westinghouse. In the rough-and-tumble battle of the patents Thomson proved to be a shrewd business man as well as a great inventor, and when the New Britain Company tried to sell out surreptitiously to a competitor, it was found that Thomson controlled all his patents.

The Thomson-Houston Company was then removed to Lynn, Mass., where under wise business management it grew and expanded into one of the great electrical companies of that period. Many other inventors were added to the staff, many great inventions were patented. The "battle of the currents" was waged between Edison, who stood for direct current, and Thomson, who favored alternating current. Similarly, a battle was fought between Edison's incandescent light and the arc light of Brush and Thomson. In the end the alternating current, with Thomson's protective grounding, and the incandescent light won the larger support.

A partial list of his nearly 700 patents includes the lightning arrestor, electric welding, three-coil dynamo, cream separator, repulsion motor, magnetic blow-out, improved transformers, distributors, trolley-car and train control, improved x-ray tubes, high frequency radio apparatus, etc.

Infringement suits between the Edison General Electric Company and the Thomson-Houston Company led in 1892 to the consolidation of the two in the General Electric Company with one principal branch at Schenectady, N. Y., and the other at Lynn, Mass. Thomson and his associates then turned to the application of his "repulsion motor" to the fruitful field of electric traction; he devised the leading type of electric meter, he experimented with x-rays and wireless.

After 1900 Thomson retired from the race of invention and devoted much attention to consultation and cooperation in many scientific and educational lines. For 37 years and until near his death at the age of 83, he continued to take an active part in the general advancement of science. He had from his earliest youth been greatly interested in astronomy, and in these later years of leisure he cooperated with Percival Lowell and W. H. Pickering and especially with George Hale. He undertook to make of fused quartz the 200-inch mirror for the Mt. Palomar telescope, but after long and costly experiments found that it was impracticable. He served for a time as acting president of the Massachusetts Institute of Technology and for many years on its board of trustees. On March 13, 1937, he died at his home in Swampscott, full of years and honors.

EDWIN G. CONKLIN

SPECIAL ARTICLES

RELATION OF DUAL PHENOMENON IN PENICILLIUM NOTATUM TO PENICILLIN PRODUCTION

DIFFICULTIES in penicillin production have been reported recently by a number of those engaged in this work. Foster, Woodruff and MacDaniel[1] state that cultures of *Penicillium notatum* Westling "tend to lose spontaneously their ability to form penicillin either entirely or partially," and that "frequently degenerated cultures show a marked reduction in the tendency to sporulate abundantly." An additional complaint concerns the increase in yellow pigment which accompanies this degeneration.

In view of the nature of the difficulty we have made a single spore analysis of a stock culture of the fungus according to the method of Hansen and Smith.[2] The results have shown that *P. notatum* is a dual fungus, composed of two distinct constituents associated together in culture. This is the dual phenomenon discovered by Hansen[3] in 1938 and which has been found to be characteristic of most if not of all fungi.

The two components of *P. notatum* are a normal conidial or *C* type and an abnormal mycelial or *M* type. The *M* type arises repeatedly as a mutation in physiologically aging colonies of the *C* type, even though the culture be started from a single conidium.

[1] J. W. Foster, H. B. Woodruff and L. E. MacDaniel, *Jour. Bact.*, 46: 421, 1943.

[2] H. N. Hansen and R. E. Smith, *Phytopath.*, 22: 953, 1932.

[3] H. N. Hansen, *Mycologia*, 30: 442, 1938.

This mutation is probably of a genetic nature, and may be associated with sex, as has been shown by the writers[4,5] in another fungus. The *M* type is physiologically as well as morphologically distinct from the *C* type, and where mass transfers of inoculum are employed the *M* type is apt to become predominant. The appearance of the *M* type *de novo* in a *C* type culture is a function of physiological age. Pure cultures of the *C* type which are maintained in a state of youth by frequent transfer (always made by means of conidia) tend to remain free of the *M* type.

Presence of the *M* type in what appears to be a normal culture often remains undetected unless the culture be frequently analyzed by the single spore technique,[2] when some of the single spores will be found to produce the normal sporulating *C* type and others to produce the non-sporulating *M* type with which is associated an increased production of yellow pigment. This *M* type (non-sporulating and pigment-producing) is presumably the form which various workers have reported as being a poor producer of penicillin. The presence of the *M* type in cultures used for inoculum would be expected therefore to result in decreased penicillin production.

If our interpretation is correct, it would appear that the highest yield of penicillin probably could be obtained by frequently making single spore cultures of the fungus and choosing the most productive of these for large-scale operations, whether these be slight variations within the *C* type or even in the *M* type.

If it is desired merely to return the present stock culture to its highest sporulating condition it is suggested that a procedure somewhat as follows be adopted. Gently flush conidia from the agar slant stock culture with sterile water. Flood the surface of an agar medium in a plate or flask with this conidial suspension; pour off the excess suspension and incubate the inoculated medium in diffuse light. Harvest the new crop of conidia soon after they are formed, again using the flushing method to avoid carrying over mycelial fragments into the suspension. This spore suspension from this fresh culture should be pure for the *C* type. Cultures must never be scraped to obtain inoculum if the *M* type is to be avoided.

M types rarely mutate. If an *M* type is found which produces a satisfactory yield of penicillin it probably may be propagated by mass transfer without recourse to the above methods. If it is desired to distribute this inoculum through a liquid to serve in place of a spore suspension the mycelial colony may be cut up by means of a Waring blender.[6]

It should be clear that to maintain penicillin production at maximum levels the highest yielding clone of *P. notatum* should be used and that this clone be kept monotypically pure and free from recurring mutants. It should be evident also that where biological assay of penicillin is practiced, the assay organism too must be perpetuated in a monotypically pure state. Only when this is done is it possible to effectively standardize the processes of penicillin production and assay.

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[4] H. N. Hansen and W. C. Snyder, *Phytopath.*, 30: 787, 1940.

[5] *Idem, Amer. Jour. Bot.*, 30: 419, 1943.

[6] C. F. Andrus, *Phytopath.*, 31: 566, 1941.

AN ANTIBIOTIC SUBSTANCE FROM SPECIES OF GYMNOASCUS AND PENICILLIUM

THE antibiotic substances from three different fungi, namely, *Aspergillus clavatus*, *Penicillium patulum* and *Penicillium claviforme*, and variously called clavacin, claviformin and patulin have proved to be identical.[1] Raistrick *et al.*[1] have elucidated the chemistry as anhydro-3-hydroxymethylene-tetrahydro-γ-pyrone-2-carboxylic acid (patulin). This substance has now been isolated from two more mold species. The first was an undefined species of *Gymnoascus*, labelled 5070.1, and kindly furnished by Dr. Thom. The second was *Penicillium* sp. freshly isolated from soil in the course of a survey. Cultivated for 7 to 10 days on Czapek-Dox medium containing 3 per cent. corn steep liquor, the *Gymnoascus* filtrate inhibited *Escherichia coli* at 1/100 and *Staphylococcus aureus* at 1/50. The active agent was adsorbed on 1 per cent. norite, eluted with acetone, and the eluate concentrated *in vacuo* to a thin syrup. After standing overnight in a refrigerator, crystals appeared. They were separated by filtration and recrystallized twice from hot 50 per cent. ethanol. The white crystals melted at 109°. A mixed melting point with crystalline clavacin (m. 109.5°), from *Aspergillus clavatus* kindly supplied by Dr. Waksman, showed no depression. The substance analyzed as follows: C, 54.72; H, 3.98 (theoretical: C, 54.53; H, 3.93); molecular weight (cryoscopic in ethylene dibromide), 195. $C_7H_6O_4$ requires 154. The 2,4-dinitrophenylhydrazone derivative began to darken at 190° and did so progressively up to 250° C. without melting. The

[1] I. R. Hooper, H. W. Anderson, P. Skell and H. E. Carter, SCIENCE, 99: 16, 1944; S. A. Waksman, E. S. Horning and E. L. Spencer, SCIENCE, 96: 202–3, 1942; H. Raistrick, J. H. Birkinshaw, S. E. Micheal and A. Bracken, *Lancet*, 245: 625–34, 1943; B. P. Weisner, *Nature*, 149: 356–7, 1942; F. Bergel, A. L. Morrison, A. R. Moss, R. Klein, J. Rinderknecht and J. L. Ward, *Nature*, 152: 750, 1943; E. Chain, H. W. Florey, M. A. Jennings and D. Callow, *Brit. Jour. Exptl. Path.*, 23: 202–5, 1942.

acetyl derivative melted at 116° (Raistrick *et al.* give 116–118°; Hooper *et al.*, 116–117°). The substance is neutral, is rapidly destroyed by alkali and decolorizes permanganate. These properties correspond with published data on patulin and clavacin, and this substance is, therefore, identical with the other two.

The pure material is quite toxic for mice. L.D. 100 = 12.5 mg per 20 g mouse. It failed to protect mice against lethal *Salmonella schotmulleri* infections in the highest doses tolerated.

A crystalline substance isolated as above with slight modifications from culture filtrates of *Penicillium* sp. also proved to be identical with clavacin. The substance melted at 109.5° and showed no depression mixed with authentic clavacin. It analyzed as follows: C, 54.92; H, 4.04. Other properties coincide with those of clavacin.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

INOCULATION OF MEDIA FOR MOLD CULTURE

IN the cultivation of molds in large flasks or bottles it is sometimes difficult to obtain a uniform degree of inoculation and to produce an even growth over the entire surface of the medium. A technique used successfully in this laboratory with several species of Penicillium employs a suspension of spores in a medium containing gum tragacanth in which a small amount of lanolin has been emulsified. The particles of lanolin apparently assist in buoying the spores to the surface of the culture medium and holding them there until germinated.

A homogenous emulsion is prepared by warming and stirring 2.5 g gum tragacanth and 0.5 g lanolin in 100 ml of water. Thirty grams of the mixture is placed in a 125 ml Erlenmeyer flask, together with five 12–15 mm glass marbles, the flask is plugged with cotton and sterilized. The flask is then rotated or shaken to emulsify the lanolin while being cooled to 30° C or below. Flasks of gum-lanolin mixture prepared in this way may be stored in the refrigerator indefinitely. To use this gum-lanolin mixture to prepare a spore suspension, the contents of one flask, including the marbles, are poured onto a spore culture grown on agar in a 250 ml flask. The flask is now shaken gently for several minutes with a circular motion in a horizontal plane to cause the marbles to roll over the spore-bearing suface. The spore suspension is further diluted for use by adding 25 ml of sterile water. The resulting suspension measures 45–50 ml and in the case of *Penicillium notatum* suffices to inoculate 15 or more 3-liter Fernbach flasks, the area of the medium in each being about 270 square centimeters. The inoculated flasks are thoroughly agitated by shaking just before incubation and are then allowed to remain undisturbed. This method is readily adapted to a sixfold increase in scale by growing the sporulation culture in a 3-liter Fernbach flask and modifying the rest of the procedure accordingly. For each Fernbach flask use 180 g of tragacanth-lanolin emulsion, increase the number of marbles to about a dozen and finally dilute with 150 ml of sterile water.

Methyl cellulose in place of gum tragacanth was not satisfactory because it did not properly emulsify the lanolin. Cetyl alcohol in place of lanolin or an eightfold increase in the amount of lanolin inhibited mold growth. If the medium being inoculated contains much suspended matter which settles out, the inoculation is less satisfactory. Presumably the material settling to the bottom counteracts the buoyant effect of the lanolin particles. This difficulty is corrected by filtration of the medium. The incorporation of a wetting agent, such as 0.1 per cent. Ivory soap or 0.4 per cent. Aerosol A.Y. in the gum-lanolin emulsion facilitated the loosening of spores from the mycelium but inhibited spore germination and mold growth.

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THE LAW OF DIMINISHING RETURNS[1]

By Dr. JOEL STEBBINS

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In the Encyclopaedia Britannica under the heading, "Law of Diminishing Returns," we find that this law was first stated in relation to agriculture:

> An increase in the capital and labor applied to the cultivation of land causes in general a less than proportionate increase in the amount of produce raised unless it happens to coincide with an improvement in the arts of agriculture.
>
> In economics, then, the law of diminishing returns is merely a precise statement of what is ordinarily recognized in the affairs of the working world. Everybody knows that, after a certain point, work in given conditions yields a diminishing return unless a better method is invented applicable to those conditions.

We in this society naturally include astronomy in the affairs of the working world, and it may be instructive to trace some of the applications of the law of diminishing returns in our own field. To begin with, this law took hold of the increasing size of refracting telescopes and brought further development to a close with the completion of the 40-inch refractor some fifty years ago. True, it was the rediscovery of the possibilities of the reflecting telescope that turned the construction of new instruments into the other form. But even if there had been no reflectors it was obvious from geometrical and optical principles, not to mention atmospheric limitations, that each increase in size of the objective of a refractor was accompanied by less than a proportionate increase of power.

The same law is now holding for reflectors even if the 200-inch, as we hope, should turn out to be a complete success. I understand that at Mount Wilson the 100-inch reflector cost about four times as much as the 60-inch, while the 200-inch will cost ten times as much as the 100-inch. No one thinks for a moment that the resulting gain in power will be proportional to the outlay. These facts are elementary to astronomers but to the laymen we might quote the simple

[1] Address of the retiring president of the American Astronomical Society, November 6, 1943.

rule that the cost of a good telescope can be roughly proportional to the cube of its linear aperture.

Despite these facts how many of us, if we were offered the money for a well-endowed 100-inch telescope, would have the moral courage to say that we would prefer to build an 80-inch and use the balance of the funds for additional improved attachments and for even better operation? The difference between 80 and 100 inches is practically not as important as the difference between poor and good seeing. Ask any observer on Mount Wilson which he would rather have, a fine night with the 60-inch or a poor, or even a fair, night with the 100-inch. The answer does not mean that the larger instrument has not been a success. Certain things have been done with it for the first time which had not been done with smaller reflectors. While experience has shown that some discoveries could have been made with smaller telescopes, the fact remains that they were not made. Near the limit of observational detection the extra power of the largest telescope available is an advantage.

My own experience with the law of diminishing returns began in another fashion years ago when I was a night assistant at the Crossley reflector of the Lick Observatory. My chief at the time was Charles D. Perrine who, to say the least, was an indefatigable observer. Those were the days, or rather the nights, of long exposures, perhaps only two plates per night, and toward dawn it used to seem to me that the last fifteen minutes of a four-hour exposure were time purely wasted. Though I did not venture to say so, I was sure that on the resulting plate no one could tell the difference between an exposure of four hours and one 15 minutes shorter, so that we might as well close up and go to bed. The answer to this argument is obvious to any one, but I could maintain that by shaving off a little time from each of several exposures we might get in an additional plate at the end.

However, Mr. Perrine kept on in his industrious way and proposed to expose for 10 hours over two nights on the region of Nova Persei. I believe that the time was cut to about seven hours by an oncoming storm, but on the resulting plate Perrine found the rapid expansion of the nebulosity about the nova, the first such motion to be discovered and one which holds the record for speed which will not be surpassed, inasmuch as it presumably represents the velocity of light.

Although this episode might justly be considered to indicate the failure of the law of diminishing returns, in another sense the instinct of a sleepy assistant was sound. Perhaps he had a feeling for the failure of the reciprocity law in photography, governing the relation between intensity and exposure time. To secure constant density of the photographic image, the time must be increased in greater proportion as the intensity of the incident light is decreased.

$$It^p = \text{constant}$$

In this equation giving the relation between intensity I and exposure t, where p is less than unity, we have the exact formulation of one law of diminishing returns.

But quite apart from the photographic action for threshold images the limit for faint stars that can be photographed with any telescope is set by the brightness of the sky background. The exposures of seven or eight hours with the Crossley reflector of focal ratio f/6, made forty years ago, are not practical now with faster modern plates. It takes an unusually dark sky to make it worth while to expose more than two hours with a reflector of focal ratio f/5. What we want is some region along the spectrum to act as a sort of window and allow us to photograph or see through to the stars and nebulae with a relatively reduced sky brightness. Such a window has been found and utilized by W. Baade with the 100-inch reflector. With red-sensitive plates and a filter transmitting the region 6,000 Å–6,700 Å he has crashed through both the atmosphere and the interstellar dust clouds to record stars that can not be reached with ordinary blue-sensitive plates. In fact, the prospect is that the beautiful and valuable photographs of the Ross "Atlas of the Milky Way" will have to be made all over again with a Schmidt telescope and red-sensitive plates.

Whereas, even without the failure of the reciprocity law, the fogging by the sky light would place a practical limit to the time of exposure of direct photographs, the same limitation does not apply in spectrum plates of moderately faint stars, where there is still plenty of contrast between a star image and the sky background. It has been said that until recently the best method of getting the red or infrared spectrum of a star was simply "to wait." By postponing the work for a year or so, one could count on the development of a new plate which would be so much more sensitive in the long wave-lengths that it seemed scarcely worth while to make the effort of long exposures with faster plates in prospect. Perhaps here is an instance of the law of increasing returns. Take things easy and some one else will make your work still easier. Seriously, he is wise indeed who can strike the proper balance between using the means at hand for a given problem and waiting for or developing new means for doing the same thing better or more easily.

At one time, when our science was being divided into the old astronomy and the new astrophysics, there were more than one of the old guard who used to say that in the astronomy of precision, as they called it, one could count upon an hour's results from an hour's work, whereas in astrophysics a large part of the experimenter's time was likely to be wasted. But

even in well-established routine researches the law of diminishing returns came into force. Consider, for example, the weights assigned to star positions from different catalogues of meridian observations. In the Boss "General Catalogue" the probable error of a position was considered to consist of two parts, the first being independent of the number of observations and the second diminishing with the number of observations according to the formula,

$$r^2 = r_0^2 + r_1^2/n$$

A glance at the tables in the "General Catalogue" shows that the weights almost never increase in proportion to the number of observations, and after a certain limit no greater weight is given no matter what the number of observations. We all probably treat our own measures of any kind in the same fashion. We repeat settings only to the point where additional ones are of little value because of the presence of errors which are not eliminated. This principle is applicable throughout physical science.

But it is not so much the fact that repeating the same work over and over leads to the law of diminishing returns as that some new method will revolutionize a whole field. When the late Dr. Frank Schlesinger took up the determination of parallaxes by photography with the long-focus Yerkes refractor, all previous parallaxes with the heliometer or meridian circle were soon superseded. Yet only last spring during my final visit with Dr. Schlesinger he remarked that the observational program for trigonometric parallaxes is about worked out. In forty years the law of diminishing returns has taken hold again.

It was Simon Newcomb, the first president of the American Astronomical Society, who said: "To be revised, pulled to pieces, or superseded as science advances is the common fate of most astronomical work, even the best. It does not follow it has been done in vain; if good it forms a foundation on which others will build. But not every investigator can look on with philosophic calm when he sees his work thus treated." Another president, Edward C. Pickering, while presiding over a session, once remarked, in a discussion of some of the new methods of stellar photometry, that he had made a good many visual photometric observations himself (the number was more than a million) but he expected them all to be superseded. In his later years Pickering decided that the magnitudes of the fainter stars could best be determined by photography and he diligently devised and carried on photographic programs. However, the visual work of Pickering still stands and will stand for a long time.

My own field of photometry may be considered to come under the law of diminishing returns, since the light from a star diminishes with the square of the distance and in proportion to the absorption in space. Over the years I have read a number of papers before the society, probably of diminishing value, and the present may be an appropriate occasion to summarize some of them. I believe that at one time I reported that the sensitivity of the selenium photometer had been increased 100-fold; at another time, two magnitudes more. Then the photoelectric cell was reported as being two magnitudes better than the selenium cell. In a few years more perhaps another 1.5 magnitudes was picked up with the photocell, and then the application of the thermionic amplifier was developed by A. E. Whitford, giving a four-fold increase or still another 1.5 magnitudes. Adding these reported improvements together we have $5+2+2+1.5+1.5=12$ magnitudes, or a factor of 63,000.

Strangely enough, something has been left out. When F. C. Brown and I first mounted a selenium cell at the focus of a 12-inch refractor and pointed the telescope at Jupiter there was no detectable response whatever. Since then the faintest object which Whitford and I have measured with a photocell is a star of magnitude 16.1 with the 100-inch reflector. As the probable error of measurement was about 10 per cent., the limit of detection may fairly be called magnitude 18. From Jupiter at magnitude -2 to a star at $+18$ the change is 20 magnitudes. This advance is perhaps not so much a measure of the excellence of the latest developments as of the crudeness of the first attempts. Moreover, we must allow say 5 magnitudes for the difference between a 12-inch and a 100-inch telescope, leaving 15 magnitudes or a million-fold improvement in the apparatus itself. The limit of magnitude 16 was reached six or seven years ago, and the law of diminishing returns is working now. We can predict with confidence that the next 20 magnitudes will be harder to get.

When my friend and colleague Jakob Kunz passed on some five years ago he was still optimistic about getting a more sensitive photoelectric surface of potassium hydride. In fact he had actually produced cells which gave ten times the response of some of the best cells on hand, but unfortunately they were not stable and the surfaces deteriorated in a few days or weeks. There are other blue-sensitive cells now available which give a response in micro-amperes per lumen considerably better than the best Kunz cells, but the commercial cells are usually not constructed with the extreme insulation needed for detecting small currents. It is the old story of what you want versus what you don't want, or the ratio of signal to noise, as they say in radio. Suffice it to say that there already exists the possibility of a photoelectric surface which, if deposited in the right way in the right cell or tube, will give greater effective sensitivity than anything so

far available, but whether the improvement will be as much as 10-fold is more than I can tell.

But how about the relative precision of measurement as the effective sensitivity of a stellar photometer was being increased? The answer is definite; while six decimal places in sensitivity were being picked up, a single decimal place in increased precision was scarcely achieved. I used to have a goal of a thousandth of a magnitude for the probable error of the magnitude of a star, but I have never reached it. However, that precision has been reached by Gerald Kron at the Lick Observatory. He has established the light-curve of at least one variable star with normal magnitudes having a probable error of ± 0.001 magnitude (*Lick Obs. Bulletin,* No. 499, 1939). As Kron has remarked to me, the limit of precision for bright stars observed with a small telescope, say up to 36 inches, is fixed not by the photocell, not by the amplifier, not even by the astronomer; it is fixed by the quality of the seeing. It took me a long time to learn that fact, but it is true, and it has been demonstrated by Whitford at Madison and Mount Wilson. Using a photocell, a short-period amplifier and an oscillograph to reveal the rapid fluctuations of a star at the focus of a telescope, he has recorded the difference between poor and good seeing. In poor seeing a star may vary four- or five-fold in intensity within 1/20 or 1/30 second, while in good seeing the maximum deviation may be not more than 10 or 15 per cent. from the mean in the course of a whole second. With a galvanometer and circuit requiring 10 or 15 seconds to give a full deflection these irregularities are smoothed out to a great extent, but under ordinary conditions with a 15-inch telescope jumps of 0.5 to 1.0 per cent. at the end of a long-period deflection are quite common. With the 60-inch or 100-inch telescope the galvanometer is much steadier at the top of a deflection, and 0.1 per cent. or 0.001 magnitude does not look so far out of reach.

An example of the futility of taking more than a reasonable number of measures of the same thing is furnished by the light-curve of the variable, Delta Cephei, which I determined visually some 35 years ago. About 7,000 individual settings were made on 72 nights, and I decided that nothing would be gained by further observations. This visual light-curve may be compared with recent curves determined with the 60-inch reflector at Mount Wilson, using a photocell and filters which isolate six different regions of the spectrum. In about a third of the observing time which had been devoted to the visual work, it was possible to get light-curves in the six colors, each one being superior to the visual light-curve. The results furnish material for the theoretical study of this type of light variation. The new curves are uniformly smooth, showing no secondary fluctuations or humps. The amplitude of variation at 3,530 Å is about 3½ times the amplitude at 10,300 Å. There is a retardation of phase for the longer wave-lengths in the sense that the maxima and minima of light are later in the infrared than in the ultraviolet. The colors of the star at different phases are quite close to the colors of normal giants, ranging from F4 at maximum to G2 at minimum in good accordance with the changes in the spectrum.

During the past ten years with my colleagues, Huffer and Whitford, I have spent a good deal of effort in determining color indices of stars with a photocell. These results have been criticized, principally by ourselves, because of the short base line or leverage furnished by the cell and filters used, the difference between the two spectral regions being little more than half the corresponding difference in the international system. The new six-color measures give so much more information about the radiation from a star that the old two-color measures are already out of date. Moreover, the extreme base line from 3,530 Å to 10,300 Å gives a scale some 7.5 times our former scale of color index. But here again, even while we are enjoying the power of the new method, the law of diminishing returns seems to have set in. The measures in the ultraviolet have been very useful in the application to extragalactic nebulae and in the determination of the law of interstellar absorption from reddened B stars, but experience has shown that for most stars a less extended base line will serve just as well. When a star's radiation is nearly a linear function of $1/\lambda$ there is no advantage in a very long base line, because of the dispersion in the characteristics of stars of the same spectral class. Moreover, the ultraviolet measures are especially affected by hydrogen absorption in some stars and by variations in our own atmosphere. Therefore, it may be best to reduce the number of colors from say six to four, omitting the ultraviolet and the blue or green.

To utilize an intermediate base line for color index we have recently tried out a cell and two filters with effective wave-lengths of 4,200 Å and 7,900 Å for a source at 10,000° K, giving a scale about 4 times the old photoelectric scale. This combination is good for the detection of small amounts of space reddening in early-type stars and is generally useful in measuring color indices of all stars. The red filter, however, transmits the radiation from what we believe to be one or more auroral lines in the neighborhood of 10,000 Å, certainly of wave-length longer than 8,500 Å. When this cell is exposed to the sky alone through an infrared filter, the relative intensity near 10,000 Å, compared with a solar type star, is 10 times the intensity of any other part of the spectrum. A further study

of this line or lines awaits the spectroscopists, but we know that the radiation is atmospheric from its irregular behavior throughout the night.

A communication from Dr. V. M. Slipher confirms the presence of this strong infrared radiation in the night sky, but he has not yet determined the wave-length. A rough comparison of the observed relative galvanometer deflections along the spectrum of the sky with the deflection from a star of spectrum dF7 is as follows:

Wave-length		3,530	4,220	4,880	5,700	7,190	10,300
Deflections,	dF7	8	8	10	8	8	8 mm
"	Sky	8	5	5	8	13	112 mm

Also, compared with other regions of the spectrum, the infrared has varied from summer to summer somewhat as follows:

1941	60
1942	80
1943	112

One is naturally suspicious of a connection with the sunspot cycle.

Even with this handicap of the sky radiation the new color system which we call C_3 can be used on the brighter nebulae, and we have started of course with M31, the Andromeda nebula, just to see what would happen. It turns out that there is a difference in the color of the two sides of the nebula which, if interpreted as the effect of space reddening like that in the galaxy, gives at once the ratio of total to selective absorption. The new results may be summarized briefly. Let A_{pg} be the total photographic absorption, E_1 the old, E_3 the new, and E the international color excess, respectively. Then the different relations and the basis for each are as follows:

(1)	$A_{pg}/E_3 = 2.01 \pm 0.10$	(p.e.)	Andromeda nebula
(2)	$E_3/E_1 = 3.86 \pm 0.13$		Reddened B stars
(3)	$A_{pg}/E_1 = 7.8 \pm 0.5$		(1) × (2)
(4)	$E/E_1 = 1.90 \pm 0.12$		Seares, A stars
(5)	$A_{pg}/E = 4.1 \pm 0.4$		(3)/(4)

The weak step in the sequence is presumably in (4), the ratio of the international to the photoelectric scale. The result by Seares is from 52 A-type stars near the north pole, and is actually the ratio of the colors C/C_1 rather than the color excesses E/E_1. The latter ratio is probably higher than the former. Unfortunately, nature has given us few B stars in the vicinity of the pole, and the interstellar absorption there is too small to give a reliable comparison of the two scales of space reddening.

It should be emphasized again that these results depend upon the assumption that selective absorption in the Andromeda nebula is the same as in the galaxy, also that the apparent surface brightness of the nebula for the regions measured would be symmetrical about the nucleus if there were no such absorption. However, the ratios in equations (3) and (5) look reasonable and the value $A_{pg}/E = 4.1$ will probably be welcomed by those who have claimed that a higher value of this ratio does not agree with the conclusions from star counts and other evidence in the galaxy.

Incidentally, if we assume that the absorption is caused by a thin layer near the median plane, these photoelectric results are in agreement with the view that the main dark lane of the nebula is on the near side, and therefore that the direction of rotation is such that the arms of the spiral are trailing.

I have included these examples from photometry not so much to illustrate the application of the law of diminishing returns as to show some efforts to combat that law. Perhaps the difference between the law of diminishing returns and the law of increasing returns is merely the difference between looking backward and looking forward. It has been well said that just as soon as a problem becomes easy it ceases to be research; if you are doing real research you are likely to be in difficulties most of the time. We have it from Bobby Jones that there is no easy shot in golf. If it is easy to get your ball on the green you should be aiming at the pin.

If I were to draw any moral from these remarks, it would be to remember that it takes only a slight improvement over what has gone before to open up entirely new opportunities. If the law of diminishing returns seems to prevent us from doing something better, we can always try to do something different.

OBITUARY

HERMAN LEROY FAIRCHILD

1850–1943

On the 29th of November Emeritus Professor Fairchild, of the University of Rochester, long an outstanding figure in American geology, passed on at the age of 93 years. Professor Fairchild was the last of a famous geological group belonging to an earlier generation, boasting many names that will be remembered as long as geologic science, as we know it, lasts.

For more than 70 years he devoted his life to education in science—teaching, lecturing, organizing, advising, investigating and writing—all with marked success. His more than 200 published writings covered a wide field and shed luster on the institution that he served with great devotion for more than a half century. He contributed much to organized science. No one in his time was more continuously engaged or more successful in developing scientific organizations to larger usefulness. He was a constructive person. Whatever he touched seemed to be improved. Every

organization grew. And it was at least in part his enthusiasm and confident service that made them grow.

In his early years, fresh from college, he became secretary of the New York Academy of Sciences. For sixteen years he was secretary of the Geological Society of America. For very many years longer he maintained close administrative and advisory relations with the American Association for the Advancement of Science, becoming a member of its executive and policy committee. He was the guiding spirit of the Rochester Academy through more than a life-time. His intimate knowledge of the steps that led to their founding and development in each case made him the natural authority on their history, and his volumes are everywhere consulted on these matters.

To Harmon C. and Mary A. Bissell Fairchild the boy named Herman Le Roy was born on April 29, 1850, at Montrose in northeastern Pennsylvania, where his boyhood and youth were spent on a farm, and where also, he secured from country schools the foundations of an education that gave bent to a long lifetime of surprisingly productive effort and wide influence. It should be noted, also, that he began at this time to show interest in geology by making a collection of fossils of his own. Later he was to develop special interest and reputation in glacial history and the interpretation of surface features of the lands affected by those events.

At the age of sixteen he began teaching in a country district school, boarding around, where he developed a liking for public speaking and a facility of expression that was to make him a powerful figure in later years. After three winters of this elementary work he was employed an additional year as clerk in a local railway freight office, but this seems to have been strictly a side issue, probably to raise funds for college. For at the age of twenty, he entered Cornell University, where he completed a regular college course and earned a B.S. degree in 1874.

Not much is known of his activities there. But it appears from subsequent events that he must have developed special competence in exposition and indulged his gift in public speaking, for it is recorded that he was a competitor for a prize in oratory. The very same year he began public lecturing, which he followed as a personal interest with marked success through all other changes for more than fifty years.

His chief life's effort, however, was spent in teaching in established educational institutions and in scientific and civic endeavor growing out of these relations. His 276 titles, several of them books and monographs, furnish a measure of his productive scholarship. Immediately upon completing his college course at Cornell, he was engaged as a teacher of natural sciences in Wyoming Seminary, at Kingston, Pa., and while there he married Miss Alice Egbert.

After only a couple of years at this place near his boyhood home, he found opportunity to continue educational and scientific work in New York City. In that city and vicinity he gave more than a hundred lectures in schools and other institutions in the first year. This was followed by a year as instructor in geology at Vassar College, and several years in Cooper Union. In that time, also, he became secretary and editor of the New York Academy of Sciences and in 1887 published a history of the Academy, which to date is the most authoritative statement of its development dating from Colonial to recent times.

During this time also he came in close contact with the American Association for the Advancement of Science. He was local secretary of the first New York meeting in August, 1887. Thereafter he held many posts in that rapidly growing organization. He was local secretary for the Rochester meeting, 1892; secretary of the council, 1893; general secretary, 1894, and member of the executive committee or committee on policy for more than thirty years. In the meantime, also, he served with the late J. McK. Cattell and others on revision of the constitution and rules, and published a brief historical account of the association in SCIENCE (Vol. 59, 1924).

He was an active member of that organization through a critical period characterized by integration and realignment of expanding scientific interests. Thus he came to be intimately concerned with developments that led to the founding of the Geological Society of America out of the overflow from Section E, which still continued to operate. He was one of the thirteen original founders of the new Geological Society as already noted, and he with Dr. Alexander Winchell formulated its first constitution and by-laws. Soon thereafter, he became secretary of the Geological Society, and was its effective administrative head for sixteen years, serving through its early formative years and probably impressing on it more of his ideas than any other man. After his retirement from the secretaryship he was honored by election to the presidency in 1912, and later was the author of its only History, which was published under the title "The Geological Society of America, A Chapter in Earth Science History," New York, 1932.

At the age of 38, long before these later events, and close upon his engagements in New York City, Fairchild had accepted a call to the University of Rochester, where he was to spend the rest of his long life. He became professor of geology and natural history there in 1888–1896 and professor of geology, 1896–1920. For ten years he was secretary of the faculty, and for thirty years curator of the Geological Museum, containing the famous Henry A. Ward Collection of geological material. In 1920 he became emeritus professor. Thus for more than twenty years he had

lived in retirement from full academic service, but his activities other than teaching were continued and he was honored conspicuously at various times in these later years. A bronze portrait bust was presented to him in 1932 by the Rochester Academy of Sciences, and in 1938 he was honored by the first award of the Rochester Municipal Museum, which took the form of a silver medal for civic achievement.

Through all his active years he continued public lectures on geology and energetically pursued investigation in his favorite branch of that science, becoming an outstanding authority on glacial geology, especially the glacial history of his own state and adjacent region. He was an official member of the New York State Geological Survey for many years and was author of several of its bulletins.

Professor Fairchild was an exceedingly active and influential man. He was widely known for his enthusiastic earnestness and evident confidence in the worthwhileness of his undertakings. No one who saw his powerful figure in action in his prime would have imagined that he had been physically frail as a child. Yet that is in the record. With the passing of youth, however, aided doubtless by his persistence in out-of-door life and in following his geological field studies, he had grown greatly in physical strength and in like measure in intellectual power. His presence was encouraging and he was welcome wherever he went. He always had an interesting contribution to make, and usually made it with telling effect. In a controversy or conference he was habitually on the winning side. But his influence was always thrown to the side that stood for orderliness and for serious-minded cooperation and for sound service in the public interest, no matter what difficulties had to be faced.

He was a born teacher with a distinct flair for popularizing. He was a far-sighted organizer and an adviser of unusual competence. He has left an indelible mark greatly to his own credit and much to to the benefit of at least four outstanding scientific organizations of this country—the American Association for the Advancement of Science, the Geological Society of America, the New York Academy of Sciences and the Rochester Academy of Sciences, and they have all lavished honors upon him. He served one of the outstanding colleges of university grade for more than fifty years, helping materially in giving it high standing in science—in the meantime making steady contribution to a better knowledge of his special branch of geologic science.

The writer of this brief note has special reason to feel his loss, for Fairchild was his earliest predecessor in one of these fields. Three years ago, in honor of his ninetieth birthday, the Geological Society presented him with a volume of letters to which he made response under date of May 1, 1940, in the following terms, "In the flood of messages and gifts, anent April 29th, the choicest and most highly appreciated is the handsome volume of letters from the Fellows of the Geological Society. This is the capstone of my scientific monument. For this I am deeply grateful to you. And I send thanks and appreciation to your office aids and the writers of the letters." By this time Professor Fairchild's physical disabilities interfered with his own reading. But of this he wrote: "with great pleasure I have listened to the reading of these cherished messages. Memory is quickened by the mention of old-time happenings, and emotion is stirred by the words of friendship, affection, approval, commendation and praise. I wish I could send personal individual reply to each writer."

Professor Fairchild long outlived the closest associates of his active days. A new generation has come into full possession of the fields since his formal retirement. He belonged to a period in which the public was beginning to take live interest in geologic science, and, to a large following, he was its prophet. He belonged to a time, also, when there was a growing need of conference and discussion. Investigation blazed with discovery. Principles were formulating. New forces were becoming engaged in factual search and the urge for meetings-together became a compelling force. In this situation Fairchild's special abilities came into fortunate relation and his talents were applied with telling effect.

He is survived by his second wife, Minnie C. Michael, whom he married in 1924, and two daughters, four grandchildren, and one great-grandchild.

In memory of a poetically gifted daughter, who died in early womanhood, the Lillian Fairchild Fund was established by him, providing an annual award to a young artist poet or writer. His own works are his memorial—these together with the affection lingering in the hearts of those who had listened to his vibrant voice and who had fallen under the spell of his impressive personality and had caught his message.

Charles P. Berkey

Columbia University

DEATHS AND MEMORIALS

Dr. Chancey Juday, since 1931 until his retirement with the title emeritus three years ago professor of limnology at the University of Wisconsin, died on March 29 at the age of seventy-two years.

Dr. Kurt Laves, associate professor of astronomy, emeritus, of the University of Chicago, died on March 25 in his seventy-eighth year.

Dr. Robert Anthony Hatcher, who retired in 1935, after serving for twenty-seven years as pro-

fessor of pharmacology at the Cornell University Medical School, New York, died on April 1. He was seventy-six years old.

DR. JOHN RICHARD FAIN, for thirty-one years head of the department of agronomy of the University of Georgia, died on March 26 at the age of seventy years.

A PORTRAIT plaque of the late Dr. Jabez H Elliott, professor of the history of medicine of the faculty of medicine of the University of Toronto, has been unveiled in the building of the Toronto Academy of Medicine.

THE American Section of the Society of Chemical Industry and the New York Section of the American Chemical Society held a joint meeting on March 31 in commemoration of "Lavoisier, the Father of Modern Chemistry." Dr. Foster Dee Snell, chairman of the American Section, presided.

SCIENTIFIC EVENTS

NEW FELLOWS OF THE ROYAL SOCIETY OF EDINBURGH

IT is reported in *Nature* that the following have been elected ordinary fellows of the Royal Society of Edinburgh: John Anthony, lecturer in botany, University of Edinburgh; Dr. Daulatrai Bhatia, senior lecturer in zoology, Government College, Ludhiana, India; Professor David Burns, department of physiology, University of Durham; John G. Carr, cancer research worker, Institute of Animal Genetics, University of Edinburgh; Dr. R. W. Craig, Scottish secretary, British Medical Association; Dr. L. J. Davies, lecturer, department of medicine, University of Edinburgh; Professor E. M. Dunlop, department of bacteriology, University of Durham; J. M. Geoghegan, president of the Society of Accountants of Edinburgh; The Honorable Lord Gibson, chairman of the Scottish Land Court; J. Methuen Graham, surgeon, Edinburgh Royal Infirmary; Professor Arthur Holmes, department of geology and mineralogy, University of Edinburgh; Dr. D. J. A. Kerr, lecturer on forensic medicine, School of Medicine of the Royal Colleges, Edinburgh; Professor J. R. Learmonth, department of surgery, University of Edinburgh; Dr. W. Ledermann, assistant lecturer and Carnegie fellow, University of St. Andrews; Dr. A. D. McEwen, chief bacteriologist, Moredun Institute Animal Diseases Research Association, Midlothian; Dr. Robert McWhirter, lecturer in radiology, University of Edinburgh; Major Noel Ewart Odell, Clare College, Cambridge; Dr. R. F. Ogilvie, lecturer in pathology, University of Edinburgh; Professor G. D. Preston, department of physics, University College, Dundee; W. S. Procter, regional engineer, Post Office Engineering Branch, Scottish Region; Dr. T. Robertson, district geologist, H. M. Geological Survey, Edinburgh; Dr. R. W. Scarff, reader in morbid anatomy, University of London; E. Openshaw Taylor, lecturer in electrical power and machinery, Heriot-Watt College, Edinburgh; Dr. O. A. Trowell, lecturer in human physiology, University of Edinburgh; Professor J. Stirling Young, department of pathology, University of Aberdeen.

THE INTER-AMERICAN WORK OF THE AMERICAN STANDARDS ASSOCIATION

IT is reported in *Industrial Standardization* that Cyrus T. Brady, Jr., and Alberto Magno-Rodrigues, of the American Standards Association, are now traveling through Latin America. Mr. Brady is general field representative and Mr. Magno-Rodrigues is in charge of the inter-American work of the association in the New York office. They are making a survey of the field as a basis for the coming year's work in inter-American standardization. Through such contact it will be possible to determine what direction our efforts must take in the light of current conditions, to improve, develop and extend the work of the department.

In each country they will interview those most interested in standardization. They will consult with the directors of existing standards organizations, government executives, the heads of technical and scientific colleges and associations, industrialists and representatives of United States firms in Latin-America.

On his way to Brazil, Mr. Magno-Rodrigues spent several days in Venezuela. He received a very cordial welcome from executives of the Venezuelan government, the Commercial and Industrial Association of Venezuela and members of United States concerns. A full description of his visit appeared in the newspapers of Caracas.

Mr. Magno-Rodrigues met with Mr. Brady and with Mr. M. E. Souza, field representative for Brazil, in Rio de Janeiro. Following this meeting Mr. Brady visited Colombia, Venezuela and Chile on his way back to New York, where he conferred with the American Standards Association regarding further coordination of the work of home and field offices on the basis of the first year's experience. He planned to visit several countries on his way back to Argentina.

It is hoped that, as a result of these journeys, a thorough picture will be gained of the present status of standardization in the various countries, so that the Inter-American Department of the American Stand-

ards Association can extend its exchange of information and material regarding proposed and existing standards with the Latin-American standardizing organization and provide an increasingly thorough channel through which inter-American standardization can be developed.

THE PUBLIC SCIENCE CENTER AT HOUSTON, TEXAS

The Houston, Texas, Parks and Recreation Department has announced the establishment of a post-war Public Science Center, in Hermann Park, with preserves in Memorial Park. Plans include, according to *Museum News,* the erection of a museum of science at a cost of $4,000,000, an aquarium and a planetarium each to cost $600,000, the complete replanning of the Zoological Park at a cost of $500,000, and a botanical garden, arboretum and wild-life sanctuary, for which the sum of $300,000 will be expended.

It is expected that funds for the project will be raised largely by public subscription. A finance committee of civic leaders has been set up. According to the statement:

Steps toward the establishment of the science center were taken in the summer of 1943 by the new director of the Parks and Recreation Department, C. C. Fleming. Mr. Fleming appointed Victor A. Greulach, associate professor of biology at the University of Houston, who is also acting director of the Museum of Natural History, to develop a natural history program for the department. A Nature Committee was formed as an advisory planning group. Its eleven members are representatives of the Outdoor Nature Club, Boys and Girls Scouts, public and private schools, the university, and other organizations. The committee put into immediate effect a natural history program for 1943, began to lay plans for a larger program in 1944, and took the first steps toward the establishment of the center.

Leadership and instruction were provided in Houston playgrounds. A Nature Guide School was conducted during July and August for playground directors and others interested. A nature trail was prepared in Hermann Park, and several playgrounds made their own nature trails. Steps were taken toward the establishment of a community forest. Ten volunteer experienced curators, under the direction of Valentine Gesner, curator of the Museum of Natural History, redecorated the museum and rearranged its collections and exhibits.

On November 19, 20 and 21 the first annual nature fair was held to call attention to the work of the department. Exhibits were nature collections and craft work by playground and school children, together with material from city and state organizations interested in conservation and natural history. There were motion pictures, woodcraft demonstrations and campfire singing. It is estimated that twenty to thirty thousand visitors were in attendance.

The program will be much enlarged in 1944. Nature trails and trailside museums are to be constructed in all the principal parks. The nature-guide school will become a year-round School of Natural History, affiliated with the university for college credit. The natural history book collection of the public library will be expanded.

THE BROOKLYN BOTANIC GARDEN

The thirty-third annual report of the Brooklyn Botanic Garden calls attention to the various ways in which the garden has assisted in the war program during the past year. As part of this service are mentioned the courses in victory gardening and public lectures on textiles and on canning and preserving; conservatory exhibits of rubber-yielding, fiber and beverage plants; cooperation with the New York Victory Garden Council and the Civilian Defense Victory Organization by consultation and lectures; demonstration victory gardens planted in a conspicuous place in the garden and viewed by thousands of visitors each week; the showing of sound films on victory gardening; a war-bond rally; the sale of defense stamps and bonds in the garden on Sundays throughout the summer; the gift of a hundred conservatory plants to the Brooklyn Navy Yard; eighty-two trees and shrubs for beautifying the grounds of the Halloran General Hospital, Staten Island; and flowers and plants for other metropolitan hospitals. More than 1,300,000 packets of seed were distributed to school children.

Attendance on the grounds was 1,465,790—slightly less than that of last year, but the attendance at the conservatories—152,578—was much greater than for many years. The combined attendance at classes and lectures for children and adults was 96,672, a considerable increase over that of last year.

Reports on research in disease resistance in the cereal grains and in the chestnut tree, on flower structure in the dicotyledons, on the flora of Western Ecuador and Peru, on North American and South American Cyperaceae and on the physiological effect of various substitute teas are included.

THE AMERICAN PHYTOPATHOLOGICAL SOCIETY

The thirty-fifth annual meeting and war conference of the American Phytopathological Society was held at the Neil House, Columbus, Ohio, from December 4 to 6, 1943. This annual meeting and war conference facilitated an exchange of ideas, facts and methods by members from various laboratories, universities, experiment stations and commercial concerns in North America. Comments indicate that this was one of the better meetings, as measured by the interest in the papers presented and discussions during the entire three-day meeting. The attendance was approximately 200. Fifty-eight papers reporting the results of orig-

inal research were presented in sections entitled "Preventive Fungicides," "Fungous Diseases and Growth Response," "Bacterial and Virus Diseases," "Soil and Seed Treatments" and "Eradicant Sprays."

In addition to these papers, there were round-table conferences. The subjects included were "The Emergency Plant Disease Prevention Program," "Vegetable Seed-borne Diseases," "War Committee Activities and Plans," "Copper and Organic Fungicides," "Extension Work in Plant Pathology" and "Cooperative Seed Treatment Tests." Interest in these conferences was high, with most members in attendance contributing to the discussions.

Officers of the society for 1944 are:

President, J. J. Christensen, University Farm, St. Paul 8, Minn.

Vice-president, J. B. Kendrick, University Farm, Davis, Calif.

Secretary, C. C. Allison, the Ohio State University, Columbus 10, Ohio.

Treasurer, R. M. Caldwell, Purdue Agricultural Experiment Station, West Lafayette, Ind.

SCIENTIFIC NOTES AND NEWS

DR. WILLIAM DAVID COOLIDGE, vice-president and director of research for the General Electric Company, and Peter Kapitza, director of the Institute for Physical Problems of the Academy of Sciences, U. S. S. R., have been awarded Franklin Medals for 1944 by the Franklin Institute, Philadelphia. The award to Dr. Coolidge is "in recognition of his scientific discoveries, which have profoundly affected the welfare of humanity, especially in the field of the manufacture of ductile tungsten and in the field of improved apparatus for the production and control of x-rays." The award to Dr. Kapitza is in recognition of the invention of a method of producing extraordinarily high magnetic fields, many times greater than were previously thought possible, and the development of ingenious methods for making magnetic measurements of various kinds upon small pieces of matter exposed for a small fraction of a second to such fields. He also designed and constructed a machine for making liquid air and liquid hydrogen which is much more efficient than any machine yet developed. The medals will be presented at the annual Medal Day ceremonies to be held at the Franklin Institute in Philadelphia on April 19.

THE first awards of the Civilian Medals for Merit, in recognition of "exceptionally meritorious conduct in the performance of outstanding services," were presented on March 28 on behalf of the Government by Secretary of State Cordell Hull, chairman of the Medal for Merit Board. Those receiving the awards were John C. Garand, head engineer of the U. S. Army Ordnance Department, in recognition of his development of the rapid fire Army rifle which bears his name, and to Dr. Albert Hoyt Taylor, chief physicist of the Naval Research Laboratory, in recognition of his work which resulted in the discovery and development of radar.

AT a ceremony held at the University of Pennsylvania Club in New York City on March 31 the annual William Guggenheim honor cup was presented to Dr. Stuart Mudd, professor of bacteriology at the university, for his work in developing methods of drying blood plasma.

IT is reported in the *Journal* of the American Medical Association that Dr. Wallace E. Herrell, assistant professor of medicine at the University of Minnesota Graduate School, Rochester, has been presented in recognition of his work on penicillin with the distinguished service key of the Rochester Junior Chamber of Commerce for "outstanding service in 1943."

JUNIUS DAVID EDWARDS, assistant director of research of the Aluminum Research Laboratories, was recently named recipient of the Pittsburgh Award by the Pittsburgh Section of the American Chemical Society "in recognition of his distinguished service to chemistry, through his fundamental contributions in the fields of gas chemistry, the chemical and physical metallurgy of aluminum and aluminum paint, and the practical application of these developments for the betterment of mankind through his activities as inventor, author and editor."

DR. GEORGE C. DUNHAM, director of laboratories of the Army Medical School at Washington, executive vice-president of the Institute of Inter-American Affairs and assistant coordinator in charge of the department of basic economy, has been awarded the Southern Cross by the Brazilian Government.

DR. ARTHUR C. COPE, associate professor of chemistry at Columbia University, will receive the Award in Pure Chemistry of $1,000 for 1944 of the American Chemical Society in recognition of "outstanding research in organic chemistry," especially in the field of plastics and drugs. The prize, which is provided by Alpha Chi Sigma, was founded in 1931 by the late A. C. Langmuir to encourage fundamental research by young chemists working in North America.

AT its fiftieth anniversary convocation the Illinois Institute of Technology conferred the honorary doctorate of engineering on Dr. Willard H. Dow, president of the Dow Chemical Company; on Dr. James A. Rafferty, president of the Carbide and Carbon Chemi-

cals Corporation, and on Dr. Charles F. Burgess, president of the C. F. Burgess Laboratories, Inc., New York City.

IT is reported in *The Times*, London, that at a congregation of the University of Cambridge on March 11 the honorary degree of M.A. was conferred upon Daniel Georges Edouard Cordier, formerly professor of physiology at the Ecole Nationale Vétérinaire d'Alfort of the University of Paris. W. K. C. Guthrie, of Peterhouse College, "welcoming to our society a gifted scientist, a strenuous ally and a kindly friend," spoke on the fame of M. Cordier in his own country and his attainments in all branches of physiology, and especially in that of respiration.

DR. CHARLES HERBERT BEST, professor of physiology at the University of Toronto, has been elected a member of the Athenaeum Club, London.

DR. DAVID P. BARR, professor of medicine at Cornell University Medical College, has been named president-elect of the American College of Physicians.

THE officers of the Society of Vertebrate Paleontology elected for the year 1944–45 are: *President*, Dr. Glenn L. Jepsen, Princeton University, and *Secretary-Treasurer*, Dr. Edwin H. Colbert, the American Museum of Natural History.

THE American Society of Plant Taxonomists has elected the following officers for 1944: Dr. William R. Maxon, *President;* Dr. Philip A. Munz, *Secretary-Treasurer,* and Dr. Henry A. Gleason, *Chairman of the Council.*

THE International Association for Dental Research at its recent meeting in Chicago elected the following officers for 1944–45: *President,* H. Trendley Dean, U. S. Public Health Service; *President-elect,* Wallace Armstrong, University of Minnesota; *Vice-president,* S. W. Chase, Western Reserve University.

THE title of professor emeritus has been conferred on Sir John Ledingham, F.R.S., on his retirement from the chair of bacteriology of the Lister Institute of Preventive Medicine of the University of London.

PROFESSOR W. H. PEARSALL, F.R.S., who has held the chair of botany of the University of Sheffield since 1938 and is at present dean of the faculty of pure science, has accepted an invitation from the University of London to become Quain professor of botany at University College.

DR. A. R. TODD, F.R.S., professor of chemistry and director of the chemical laboratories of the University of Manchester, has been appointed professor of organic chemistry at the University of Cambridge as from September, 1944.

ODELL JULANDER, of the department of forestry of Iowa State College, has been named chief forester and associate professor of forestry at the University of Arkansas.

DR. EDWIN R. HENSON, regional agricultural analyst of the Bureau of Agricultural Economics of the U. S. Department of Agriculture, has been made chief of the division of agricultural rehabilitation of the United Nations Relief and Rehabilitation Administration.

DR. IRVING GRAEF, Major, M.C., on leave of absence as associate professor of pathology at the College of Medicine of New York University and as pathologist in the Bellevue Hospital, New York, has been appointed director of the Medical Research Laboratory at Dugway Proving Ground, Tooele, Utah. This laboratory is an installation of the Medical Division of the Office of the Chief of Chemical Warfare Service.

DR. BENNETT F. AVERY, dean of the School of Medicine of Boston University, has resigned to accept an appointment as director general of public health of Iran.

DR. EMMELINE MOORE, chief aquatic biologist, director of the Biological Survey of the Conservation Department of New York State, who has served in this capacity for twenty-five years, retired on March 30.

IT is reported in *The Experiment Station Record* that Edward L. Tanner has been assigned to the Coöperative Experiment Station in Nicaragua to conduct agronomic work on coconuts, sesame and other oil-yielding plants, on rice, and on abacá, a source of fiber. He will establish demonstration plantings on private farms and assist in training Nicaraguan personnel at the station. Benjamin Y. Morrison, principal horticulturalist in charge of the Division of Plant Exploration and Introduction of the Bureau of Plant Industry of the U. S. Department of Agriculture, is assisting in the coordination of the agricultural research program in Colombia, especially as it relates to the production of cinchona.

DR. MARSHALL KAY, associate professor of geology at Columbia University, has been appointed special lecturer to visit the various local sections of the American Association of Petroleum Geologists. He is visiting some fifteen chapters during the spring giving lectures on "Geosynclinal and Continental Development."

DR. RICHARD E. SHOPE, a member of the Rockefeller Institute for Medical Research in the department of animal and plant pathology at Princeton, N. J., commander in the U. S. Naval Reserve, delivered at the Johns Hopkins Hospital on March 16 and 17 the fourteenth course of lectures under the William Sydney Thayer and the Susan Read Thayer lectureship in clinical medicine. His subject was "Old, Intermediate

and Contemporary Contributions to Our Knowledge of Pandemic Influenza."

DR. WILLIAM E. SHOUPP, manager of the Electronics Department of Westinghouse Electric and Manufacturing Company, gave on March 17 at Miami University a lecture on "Nuclear Physics" under the auspices of Sigma Xi and Sigma Pi Sigma. In addition to faculty and civilian students, approximately 200 V-12 students were in attendance.

THE ninth annual Harrison S. Martland Lecture of the Essex County Anatomical and Pathological Society was given at the Academy of Medicine of Northern New Jersey, Newark, on March 22 by Otto Loewi, research professor of pharmacology at the New York University College of Medicine.

DR. E. B. COWDRY, professor of anatomy of the Washington University School of Medicine, St. Louis, addressed the Los Angeles Academy of Medicine on March 3. His subject was "Precancerous Lesions."

THE Georgia Section of the American Chemical Society held a special meeting in LaGrange on March 18, under the auspices of Callaway Institute, Inc. The meeting was arranged to permit the members of the society to attend a lecture on "The Chemical Structure of Textile Fibers" by Dr. Milton Harris, director of research for the Textile Foundation of Washington, D. C., who was visiting the institute at that time. In addition to the lecture, there was an inspection tour of the institute, a visit through one of the weaving plants of the Callaway Mills, and a dinner for visitors.

THE New York Medical College has recently received gifts in memory of John Eastman Wilson from Mrs. Wilson. Dr. Wilson was professor of neurology and was associated with the college from 1902 to 1918. The sum of $100,000 is designated as a student loan fund for needy medical students and a second gift of $10,000 has been added to the endowment of the department of surgery.

CHEMICALS wanted by the National Registry of Rare Chemicals, Armour Research Foundation, 33rd, Federal and Dearborn Streets, Chicago 16, Ill., include: straight-chain organic acids of 35 to 45 carbon atoms; Cytosine (approx. 10 grams); dl Camphenilone; Coniferyl alcohol; Cadion 2B (4-nitro-l-naphthalenediazo-p-amino azobenzene); 7-Dehydrocholesterol (1 to 10 kilos); Desoxyribose; Distearyl sulfone; Epicatechin (3,5,7,3′,4′-flavanpentol); d or l-galacto ascorbic acid; l-gluco ascorbic acid; Indazole; Alpha ketoglutaric acid; Phloridzin; Tetrophine (5,6-dihydro-1,2-benzacridine-7-carboxylic acid); Kynurenic acid, and Xanthurenic acid.

DISCUSSION

PEACETIME RESEARCH IN WARTIME—A REPORT

IN June, 1943, the following letter was sent to 212 zoologists now in active service with the armed forces:

Dear Colleague:

This letter is addressed to you, among others, as a fellow scientist who interrupted the pursuit of your chosen field in order to enter the Services. Many of us who, because of age or other circumstances, remain at home, are much torn between conflicting attitudes regarding the continuation of scientific and scholarly activities in the midst of war. Probably all of us are in some way part of the general war effort. We teach now nearly exclusively premedical and nursing students, and this serves the immediate preparation for their war-important professions. Many of us also participate in special war research projects of biological or physiological nature. Some of us do not seem to possess any skills which make us valuable as direct contributors to war research. The question in our minds is this: Should we devote every hour of our time to efforts of immediate war usefulness, or should we reserve a fraction for the continuation of the research lines which were thought fruitful in a more peaceful period? We see arguments for and against either alternative. When the roof is on fire, we feel, to put out the flames is the only task behind which everything else should disappear—but we wonder whether the analogy between the few inhabitants of a house on fire and a nation at war is correct enough to warrant the conclusion that we should stop all scholarly work. We feel that the permanence of peaceful human endeavors can be assured best if we devote some time to keeping them going in wartime—but we wonder if this sentiment is only an expression of egotistical desires, of our personal pleasure in such activities.

Obviously, the question can not be decided by vote. However, it seemed to me that an expression of the opinion of our colleagues now in the Services might be of help to us at home. You may not be unbiased either; perhaps you are even shocked by the fact that questions like the one raised in this letter are under discussion at all. Whatever your opinions, should you be able to spare the time, it would be of great help to us to hear them expressed. . . .

(Signed) CURT STERN

All names were obtained by writing to sixty-six departments of zoology and asking for a list of staff members and graduate students then in the services in order "to address to them some questions bearing on science." The sixty-six institutions were selected as likely to be concerned with research in normal times. Replies were received from forty-five departments distributed widely over the country. Of the 212 letters

sent to individuals, 13 were returned marked "no record." This leaves a maximum of 199 letters which may have reached their destinations. Replies were received from 42 men, a return of about 20 per cent. Whether this should be called a low return, considering the highly selected group of recipients, or a high return, considering the demands of military life, is uncertain. It is also unknown how representative this sample is of the opinions of all zoologists in the Armed Forces. Nevertheless, an analysis of the answers is of general interest.

Intentionally, the problem was not formulated as a questionnaire; consequently, the replies did not follow a simple pattern. The first overall impression is that of intense interest. Many replies were several pages long, few only half a page. The classification of all the opinions expressed involves some subjective element, mainly due to the fact that any useful classification entails a neglect of the many individual shades of conviction. Leaving out one letter which clearly did not touch the problem posed, four categories of opinion were distinguished regarding the continuation of some "peacetime" research. These opinions, together with the arguments given for them, may be summarized as follows (each of the following quotations comes from a separate letter):

(1) *Complete discontinuation.* It is argued that all but war research should be postponed in order to secure first the liberty which will make possible later the renewal of peacetime work. "The more completely this translation of effort becomes effected, the sooner victory is assured for forces in combat. There will be plenty of time when the war is over for non-essential, cultural pursuits."

(2) *Continuation but in spare time only.* Peacetime research should be continued even in wartime, the arguments run, but this work should be pursued when other men, including soldiers, rest from their day's labor. Free research is seen by some as of general intrinsic value, by others as a means of furnishing necessary refreshment to those who devote themselves full time to the war activities of teaching and/or war research. "Recreation is as indispensable in wartime as in peacetime. Who can blame the university teacher if he chooses to devote to fundamental research the time he might otherwise spend in listening to some frenzied radio news analyst?. . . "

(3) *Continuation, after self-searching inquiry as to the basic importance of the work.* Men expressing this opinion believe in the basic value of peacetime research as part of our civilization. They stress, however, the obligation of the scientist to test himself, his motives and his projects so as to carry out research as a responsibility to society. They demand selection of important problems, discontinuation of playful techniques and all-too-private interests. A decision will depend "on the importance of a man's research program and his abilities. A great many workers are "diddlers" . . . they might well devote their energy to the war effort. There are other men whose work in the field of pure science is extremely important and certainly these men should be allowed to continue their investigations." Scientists "should reexamine their individual research projects in the light of their value to the whole scientific framework of our civilization . . . strengthen their philosophy of science."

(4) *Unqualified continuation.* This term is applied both when the writer approves of setting apart a fraction of the investigator's time for peacetime work, and when even more time for research of this kind is favored. Such continuation is an essential part of what we are fighting for. "It seems . . . to be a glowing tribute to the American way of life that research . . . is being carried on *in spite* of the war." It is "part of the battle for the freedom of the mind." "Scholarship must not be put into the luxury class." Several writers take up the simile of the house on fire which was used in the letter to them. "It is wise to have some people protect the valuables in the house." Another opinion which occurs in six different letters states that men at home "should work toward maintaining a civilian standard of science and culture that men will be glad to come back to." "I know that I hope strongly to return to a laboratory where an active research program is under way." Finally, it is argued frequently, "that if we lay aside and forget our ideals for any lengthy period of time we may fail to assume them again when the appropriate time to do so returns."

TABLE 1

OPINIONS OF ZOOLOGISTS NOW IN THE ARMED FORCES CONCERNING PEACETIME RESEARCH

		Discontinuation	Continuation: In spare time	Continuation: If important	Continuation: Unqualified	Total
	/	4 + 2?	4 + 1?	3	26 + 1?	41
Academic status	Ph.D degree	5	2	1	12	20
	No Ph.D. degree	–	2	1	7	10
	Unknown	1	1	1	8	11
Military rank	Commissioned officers	3	2	3	16 + 1?	25
	Enlisted men	3	3	–	10	16

A question mark signifies some doubt as to the correct classification.

Table 1 summarizes the number of replies in each category. It also contains some data on the peacetime

status of the writers and on their military rank. The majority of the answers came from men in this country, but those from overseas did not differ significantly from the whole group. Personal acquaintance of the writers with the author of this survey (eight cases) did not seem to influence the opinions expressed as shown by the fact that the answers were representatively distributed.

In summary, thirty-five of these forty-one zoologists now in the Armed Forces believe that peacetime research should be carried on in wartime, "in spite of war" and even with "redoubled efforts." Of these, five are for continuation in spare time, three with restriction to important problems, and twenty-seven for more or less unqualified continuation. Six men are against continuation. It would be of interest to know what the majority of men in other fields of science, of the humanities and in general think about the problem raised.

CURT STERN

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THE 24-INCH OBJECTIVE PRISM OF THE WARNER AND SWASEY OBSERVATORY

ONE month before "Pearl Harbor," the 24-inch Schmidt-type telescope and the building addition to the Warner and Swasey Observatory of the Case School of Applied Science were completed. Plans for an objective prism for this instrument were executed in conjunction with the design of the mounting, and the Bausch and Lomb Company agreed to furnish us with a suitable disc of optical glass for this purpose. On December 12, 1943, the completed prism was finally mounted on the telescope and during the succeeding two months extensive tests were made with it.

The one-lump mass of glass for the disc was chosen from one of the pots of optical glass. The 260-pound piece chosen was free from deep striations and air bubbles. This huge mass, one of the most perfect ever produced, was molded to shape in a deep furnace utilizing a pot design to produce a wedge shape. The flat surfaces were then polished and the disc examined with polarized light. No strains were detected. Later tests showed that the annealing of the glass was excellent. The diameter of the finished disc, before being reduced in the optical shop, was 26.75 inches; the thickness varied from 3.0 to 4.3 inches. The refractive index of this light flint glass is 1.617 with dispersion ratio of 36.6.

The grinding and polishing of the prism was executed in a most satisfactory manner by C. A. Robert Lundin, of the Warner and Swasey Company. This firm has also constructed and erected the Schmidt-type Burrell telescope of the observatory and the dome.

The diameter of the finished prism is 24.5 inches, with clear aperture of 24.0 inches and with graduated thickness from 0.75 to 2.5 inches, producing an angle of 4 degrees. The finished prism weighs 100 pounds.

The prism cell mounting is so constructed that when in place it may be easily rotated through any desired angle in a plane perpendicular to the optical axis of the telescope. The cell with the prism forms a symmetrically balanced mass of 150 pounds. A 26-inch ring-weight of 150 pounds situated in front of the correcting lens is first removed from the telescope when the prism is to be mounted, thus avoiding any re-balancing of the instrument.

The optical system of the Schmidt telescope is composed of a 36-inch mirror of pyrex glass with aluminized surface and a 24-inch correcting lens of Vitaglass, 0.34 inch thick. The effective focal length of the instrument is 84 inches. The plate holder is circular and adapted for plates 8 inches in diameter yielding a field of 5°.

The combination of the prism and telescope produces spectra of 3.2 mm in length from H_β to H_ϵ. The quality of the spectra appears excellent. In the spectrum of the F_5 star α Persei 21 lines in the region from H_β to H_{16} have been identified. Both focal images and spectral images are of excellent definition to the very edge of the plate.

The main program of the prism telescope combination will be the study of the structure of the galaxy through spectral type distributions and related problems. Plates already secured indicate that absolute magnitude classification as well as spectral types may be readily studied with these small scale spectra.

J. J. NASSAU

CASE SCHOOL OF APPLIED SCIENCE

DIGESTIVE AVAILABILITY OF BEAN STARCH

IN view of the present emphasis on the use of dried beans a brief account of some additional observations on digestive factors in navy beans may be of interest. It was recently found that the ether-soluble fraction of these beans retards the *in vitro* digestion of soluble starch more than some of the other edible fats. In an earlier note[1] attention was called to the interference which is observed when the total ether-soluble fraction is added to soluble starch in the same concentration in which it occurs in the beans or about 1.5 per cent.

Employing 1 per cent. solutions of soluble starch adjusted to pH 7 with phosphate buffer, further study has shown that various preparations of starch and navy bean oil differ in the ease with which they are completely digested when sufficient pancreatic amylase is added to digest untreated control starch or starch containing 1.5 per cent. of olive oil, lard or butter

[1] D. E. Bowman, SCIENCE, 98: 308, 1943.

within 30 minutes. Estimation of the amount of reducing sugars formed indicates that in the great majority of these artificial bean-oil preparations the undigested residue which is responsible for the positive starch-iodine test and which resists digestion for some hours after the control preparations are digested does not exceed 5 per cent.; however, in some cases this fraction was observed to be much greater. Sodium chloride was added to obtain maximum activity of the enzyme.

The reason for this variation and the relation of the ether soluble factor in the intact bean to the delayed digestion of bean starch is being studied further. The relative inaccessibility of the bean starch to *in vitro* digestion by pancreatic amylase is apparent when soaked whole beans are heated and crushed under conditions which more than suffice to render the starch of potatoes quite available. When digested as described with equal starch concentrations the difference in the amount of reducing sugars formed in the two cases is very striking. The starch of beans which are finely ground before cooking appears to be more easily digested than that of the beans which are cooked whole and then mashed.

Procedures other than prolonged heating employed in compensating for the delayed digestion include the well-known action of acids upon insoluble starch as well as treatment with yeast and enzymes of barley malt. While the yeast has many obvious advantages in adding desirable nutritional factors simple preliminary treatment with acid with subsequent neutralization appears to be more practical and efficient than the latter in accelerating the digestion *in vitro*.

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DEMONSTRATION OF THE FORMATION OF A FILAMENT FROM TISSUE CONSTITUENTS IN VITRO

It has been possible during the past four years to entertain visitors to this laboratory with an *in vitro* demonstration of what we have extravagantly termed a "nerve regeneration." A perfectly formed spiral filament can be precipitated from a phosphate extract of brain tissue when a direct current is passed through the material confined in a glass tube of small diameter. This demonstration has served to mystify the skeptics and impress the more gullible of my less scientific collaborators. The interest expressed justifies the recording of this phenomenon, which was first observed during the course of some experiments on the cataphoresis of a mixture of brain proteins.

The demonstration may be repeated as follows: 12 inches of glass tubing with an external diameter of approximately 3 mm (internal diameter may vary between 1 and 2 mm) is bent into a "U" tube approximately 5 inches tall. The tissue extract is prepared by taking one volume of brain cortex (freed of the more obvious blood vessels) and mixing with two volumes of .02 M phosphate buffer, pH 7.3, in a small mortar and pestle, where it is ground until it is quite homogenous. This mixture is centrifuged at 1,500 r.p.m. for approximately 15 minutes, or until the gross particles are separated from the supernatant extract. It is not necessary to centrifuge until the supernatant is perfectly clear. Some of this extract is transferred to the glass "U" tube with the aid of suction and 110 volts of direct current are applied to this mixture with the aid of platinum electrodes inserted in both ends of the "U" tube. The platinum electrodes are made from pieces of platinum wire, gauge No. 22. Contact between the solution and the platinum is made by inserting the wire a distance of 1/16 inch below the surface of the mixture. Shortly after the current is applied a small precipitate begins to form at the anode (acid-forming pole). This precipitate extends itself to form a thin filament which spirals down the tube to form what looks like a fine spring. The thickness of the filament will vary depending upon the strength of the current and the density of the tissue extract. Reversing the polarity of the current causes solution of the filament by the alkali formed at the cathode.

It has been possible to make these spiral filaments from the brains of rats, hogs, cattle, rabbits and man. Attempts to duplicate this phenomenon with tissue extracts from other organs have not been successful in the few trials attempted nor has it been possible to date to duplicate the experiment with solutions of purified proteins.

The filament formed has low tensile strength but with care can be removed from the glass tube. It is not pure protein but is a mixture of most of the components of the original extract.

The explanation of this phenomenon may depend in part upon the fact that the protein in solution in the brain extract is precipitated when the acid is formed at the end of the anode. The orientation of this precipitate into a spiral may be influenced by the shape of the vessel in which it is formed, the electrical field of force about the precipitate and the movement of the fluid in the container.

The biological significance of this demonstration can be almost anything the imaginative reader cares to imply. Additional work is indicated.

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SCIENTIFIC BOOKS

MEDICINE

A Hundred Years of Medicine. By C. D. HAAGENSEN and W. E. B. LLOYD. Pp. xii + 444. 42 illustrations. New York: Sheridan House, Inc., 1943. $3.75.

ANY good book has a personality which in turn implies a pleasant inheritance and a good upbringing. This particular book certainly has a substantial family tree and a sound educational background, for it represents an alliance between the two Cambridges—Cambridge, England, and Cambridge, Massachusetts. One of its authors, Dr. Haagensen, graduated from the Harvard Medical School, and the other, Dr. Lloyd, received his bachelor's and master's degree from the older university.

In 1936, Dr. Lloyd was induced to write a book called "A Hundred Years of Medicine." At that particular time the publishing house of Duckworth in London was putting out what it called the "Hundred Years Series." The books in this series dealt with such varied topics as psychology, transport, anthropology and government, and also included medicine. One gathers that their purpose was to describe for British readers a century of progress in several different fields.

Dr. Lloyd's book was 344 pages long, was unillustrated and sold for fifteen shillings. It must have created a favorable impression in England and have been well received by the medical profession there, since both the *Lancet* (135–136, July 18, 1936) and the *British Medical Journal* (392, August 22, 1936) at once spoke highly of it. Each of these critics emphasized that the book told the story of a century's history of medicine accurately and entertainingly and was certainly the kind of a volume that any one who cared for reading would enjoy.

Certain copies of it reached this country; apparently, however, not many medical men saw them. The book was not reviewed in such periodicals as the *Journal* of the American Medical Association, the *Archives of Internal Medicine* or other journals which are in the habit of reviewing medical books, and no copies of it are to be found in such representative literary lodging houses as the Boston Medical Library and Harvard University; yet certain physicians became acquainted with it because the New York Academy of Medicine owns a copy and there must be at least one copy in Philadelphia, since it was reviewed in the *American Journal of Medical Sciences* (194: 276, August, 1937).

On the whole, the American reception of Dr. Lloyd's book was anything but cordial. I have been unable to find any reviews of it by non-medical writers, and our doctors were equally indifferent. E. K. of the *American Journal of Medical Sciences* said that any one who digested it would be well informed on the progress of medicine in the past century; but in general too few doctors made its acquaintance to allow it to win the reputation it deserved.

As one rereads it, the first edition was a pleasant affair. It began with a quotation from Burton in "The Anatomy of Melancholy" and surely no more graceful introduction to a volume on the history of medicine is possible than his words: "How many excellent physicians have written just volumes and elaborate tracts of this subject? No news here: that which I have is stoln from others; *dicitque mihi mea pagina, fur es.* If that severe doom of Synesius be true, *it is a greater offence to steal* dead mens labours, than their cloaths, what shall become of most writers? I hold up my hand at the bar amongst others, and am guilty of felony in this kind." The book went on from this beginning to give an instructive and lively account of what has happened in the field of medicine from 1832 until 1934. The style was pleasing, the material that was used was diverse, and the manner in which it was presented was delightful. There was a timetable of events of medical importance at the end—in itself a useful compilation for any one to be able to lay hands on. On the whole, it is easy to see why our British colleagues spoke so favorably of the book and still difficult to understand why so few people on our side of the Atlantic accepted it.

The new edition which has just appeared includes the contents of the first edition brought up to date and also a good deal of extra material. It is now a collaborative enterprise and its two authors have dovetailed together each other's views so as to make an appetizing mixture of the whole for readers on either side of the Atlantic. When all is said and done, the last century was a fertile period for medicine; the chief difficulty for the authors was to decide what to leave out.

There are certain obvious gaps in the book which individual critics may seize upon. For example, the medical adventures of Alexis St. Martin were omitted, an oversight which the *Rhode Island Medical Journal* (26: 313, December, 1943) objected to, and the valuable timetable of significant medical events of the past century has been deleted. The majority of physicians who see it, however, will agree that here is a readable book worth reading and recommendable to their colleagues, friends and students.

It is nicely printed, well indexed, the illustrations which are scattered through the text are interesting,

the bibliographic references that accompany each chapter are well chosen, and the story is fascinating of how many advances in different and apparently unrelated fields of medicine have been correlated to advance knowledge. The final chapter gives a fair and impartial account of the current trend towards the socialization of medicine.

The second edition of "A Hundred Years of Medicine" bids fair to achieve the general popularity it deserves. After a seven-years' sleep, and in a new dress, at last the book will come into its own.

Reginald Fitz

CALCULUS

Calculus. By Lyman M. Kells. Prentice-Hall. $3.75.

Professor Kells's attractive new book can be warmly recommended as an introduction to the calculus. He has given real life to the fundamental abstract ideas, by well-chosen and often original verbal and pictorial illustrations (there are 325 figures). In the same spirit, he has driven home the practical value of the calculus as a method by an immense variety of concrete problems. The result should be to embed the calculus permanently in the thinking processes of even mediocre students, and the reviewer intends to try the text in his own first-year courses.

On the other hand, he does not feel that Professor Kells's book will develop sufficiently the critical ability of more advanced students. No warning is given that one may be led into error by believing the "obvious," and no apology is made for introducing convenient "assumptions" in order to minimize the difficulties of proof. In fact, the "proof" at the top of page 409 is grossly wrong; so is the "assumption" at the beginning of §174; the function $\exp(-1/x^2)$ being a well-known counter example which appears in most rigorous texts. When such errors are corrected in later editions together with numerous misprints, the book should be admirably suited to first-year students.

Garrett Birkhoff

Harvard University

SPECIAL ARTICLES

THE RED AND GREEN LIGHTS OF THE "RAILROAD WORM"

A few luminous animals are known which emit light of two different colors. One of the most striking of these is the South American railroad worm or "ferrocarril," of the genus, Phryxothrix, a beetle of the family Phengodidae, related to fireflies. The adult male has typical beetle characteristics and long branched antennae. The adult female, nearly two inches long, is larviform, with eleven pairs of brilliant greenish yellow luminescent spots on the sides of the body and a red luminous area in the head. The larvae of both male and female also possess similar luminescent spots. In North America, the rare closely related insect, Phengodes, occurs, with rows of green lights, but lacking the red light in the head.[1]

Thanks to the kindness of Dr. H. L. Parker, of the U. S. Department of Agriculture, I have recently received from Uruguay several living specimens of Phryxothrix in excellent condition. One was an adult female and the others probably larvae. They showed no light when at rest but if disturbed very slightly, by knocking the table gently or blowing air over them, they responded by shining the red light. When the disturbance was greater the rows of greenish lights also appeared and the animal explored its environment with a brilliant display of pyrotechnics. The red light in the head resembled the tip of a glowing cigarette. Sometimes all and sometimes only certain of the greenish lights would be turned on. Later the greenish lights went out while the red remained on for some time, finally to disappear as the animal became quiet again.

With these specimens it has been possible to determine the nature of the red luminescence. There are three ways in which a red light might be produced: (1) By emission of red wave-lengths, a red chemiluminescence; (2) by the presence of a red color screen transmitting red but absorbing other wave-lengths; (3) by red fluorescence of a compound, excited by shorter wave-lengths emitted by some chemiluminescent reaction. The first method is the one used in producing the red light, as indicated by the following experiments.

If the red luminescent material is dissected out of the head of Phryxothrix and examined on a slide in day-light, no red pigment can be detected.[2] The tissue appears colorless and the easily visible (in the dark) red luminescence could not be due to a red color screen or to absorption by the chitin of the head, which is a light brown in color.

When hydrogen or nitrogen gas is passed over the excised red luminescent tissue in the dark, the red light disappears, and if the potentially luminous substance is now exposed to near ultra-violet light without the visible (from a mercury arc filtered through Wood's

[1] See the description in "Living Light," by E. N. Harvey, Princeton University Press, 1940, p. 69.

[2] A very weak solution of some red compound might be present, too dilute to appear red by absorption but concentrated enough to luminesce with a red emission. The luminescence of colored compounds can be detected in concentrations too weak to appear colored.

nickel glass), no red fluorescence can be detected. Since this near ultra-violet light is especially active in exciting fluorescence of a wide variety of organic compounds, we can conclude that the red luminescence is not a fluorescence.

When oxygen is readmitted to the luminous organ the red luminescence reappears, indicating that the red light is a red oxidative chemiluminescence comparable to that resulting from oxidation of Mg and Zn complexes of certain porphyrins, phthalocyanines and chlorophyll derivatives, as described by a mumber of investigators.[3] Although no red pigment is visible in the luminous tissue, a red pigment is present in the body of Phryxothrix. It is not known whether this pigment is a porphyrin or whether it is concerned in light production.

The light of the greenish luminescent organs also disappears in absence of oxygen and returns in its presence, as does the luminescence of the firefly and many other luminous animals in which the light is also an oxidative chemiluminescence. It is futile to speculate concerning the nature of the luminous substance responsible for the red and green luminescences in the same animal. Indeed the mechanism of luminescence in the fireflies and related insects needs further investigation. There is some evidence that the luciferase-luciferin system is actually an enzyme-coenzyme system, as I have previously suggested.[4] A more abundant supply of this rare and fascinating South American beetle would greatly aid in clearing up some of the chemical aspects of bioluminescence.

E. Newton Harvey

Princeton University

IDENTIFICATION OF THE FLUORESCENT SUBSTANCE F_2[1]

In 1940 Najjar and Wood[2] described the presence of a fluorescent compound obtained from urine eluates after treatment with the alkali and butanol, which was dependent on the intake of nicotinic acid.

This substance, subsequently designated F_2, was unobtainable from the urine of pellagrins[3] and animals with black tongue,[4] a fact which has been made the basis of a useful test for identifying nicotinic acid deficiency.[5] The chemical nature of F_2 has been investigated in this laboratory[6] and elsewhere.[7-11] We reported striking similarities to the fluorescent reduction products of N-methyl nicotinamide. In a simultaneous and a subsequent report[8, 9] Huff and Perlzweig prepared N-methyl chloro-nicotinamide and claimed that F_2 could be identified as N^1-methyl nicotinamide, an obvious error in view of the fact that solutions of N-methyl chloro-nicotinamide are non-fluorescent.

It appears certain, however, that the precursor of F_2 is a derivative of N-methyl nicotinamide, since we have obtained the same fluorescent compound F_2 both from urinary eluates and from aqueous solutions of the chloro-, bromo- and iodo-derivatives of N-methyl nicotinamide. The final product is free from halide, indicating that alkali treatment displaces the anion of the F_2 precursor, thus obscuring its identity. Huff and Perlzweig showed that picrates made from urinary eluate and from N-methyl chloro-nicotinamide had identical melting points (189.5° C), a finding we have confirmed. This method of approach, however, does not shed any more light on the nature of the anion which is displaced by picric acid. We have prepared halogen-free picrates from N-methyl chloro-, bromo- and iodo-nicotinamide that were identical with that obtained from the F_2 precursor in urine eluate in individual and mixed melting points (189.5° C). It is, however, possible that treatment with picric acid may detach some substituent group at another portion of the molecule than that occupied by the halide. The identity of the picrates therefore does not prove that their precursors were identical. In this connection it is of interest to note that Coulson and Ellinger,[10, 11] although they confirmed the identity of the picrate from urine and from N-methyl chloro-nicotinamide, obtained an aurate from these two sources which differed both in color and melting point. For the present, therefore, the identification of the non-fluorescent precursor of F_2 remains incomplete.

The present communication deals with the chemical changes concerned in the conversion of the non-fluorescent precursor into the fluorescent F_2. Studies of N-methyl pyridines as well as N-methyl quinolines and acridines[12, 13] have shown that a quaternary pyridinium base is first formed which, by rearrange-

[3] See P. Rothemund, *Jour. Am. Chem. Soc.*, 60: 2005, 1938, and J. H. Helberger and D. B. Hever, *Ber. d. d. Chem. Ges.*, 72B: 11, 1939.

[4] E. N. Harvey, Science, 44: 652, 1916.

[1] The work described in this report was carried out under a grant from the Williams-Waterman Fund of the Research Corporation.

[2] V. A. Najjar and R. W. Wood, *Proc. Soc. Exp. Biol. and Med.*, 44: 386, 1940.

[3] V. A. Najjar and L. E. Holt, Science, 93: 20, 1941.

[4] V. A. Najjar, H. J. Stein, L. E. Holt and C. V. Kabler, *Jour. Clin. Invest.*, 21: 263, 1942.

[5] L. E. Holt and V. A. Najjar, *Journal-Lancet*, 63: 366, 1943.

[6] V. A. Najjar, D. B. M. Scott and L. E. Holt, Science, 97: 537, 1943.

[7] J. W. Huff and W. A. Perlzweig, Science, 97: 538, 1943.

[8] J. W. Huff and W. A. Perlzweig, *Jour. Biol. Chem.*, 150: 395, 1943.

[9] R. A. Coulson, P. Ellinger and B. S. Platt, *Biochem. Jour.*, 36: 12, 1942.

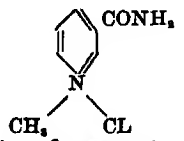
[10] P. Ellinger and R. A. Coulson, *Nature*, 152: 383, 1943.

[11] R. A. Coulson and C. Ellinger, *Biochem. Jour.*, 37: 17, 1943.

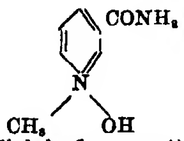
[12] E. Decker and A. J. Kaulfmann, *Pract. Chem.* (2) 84: 432, 1911.

[13] Taylor and Baker, "Sidgwick's Organic Chemistry of Nitrogen," p. 524, Clarendon Press, Oxford, 1937.

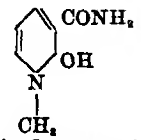
ment, is in large part converted into a carbinol. Such carbinols combine readily with alcohols to form carbinol-ethers. In the case of N-methyl chloro-nicotinamide, when treated with alkali and isobutanol, the reactions would be as follows:



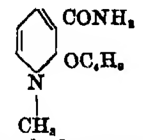
(non-fluorescent)
Quaternary salt



(Slightly fluorescent)
Quaternary base



(Slightly fluorescent)
Carbinol



(Very strongly fluorescent)
Carbinol-ether = F_2

Upon treatment of purified urinary eluate and of N-methyl chloro-nicotinamide with alkali, fluorescence develops at once, though consistently more rapidly with the former. The absorption spectra of both products are nearly identical (max. 264 μ, min. 250 μ). We were led to the conclusion that the resulting carbinol must form a condensation product with the alcohol from the observation that minute additions of isobutanol to the alkaline carbinol solution, insufficient to cause separation of an alcohol layer, caused nevertheless a very striking increase in fluorescence. The formation of a carbinol-ether is not an instantaneous reaction, but continues to progress even after an isobutanol extract has been made,[2] which explains the hitherto puzzling increase in fluorescence on standing. When the isobutanol extract is evaporated to dryness the carbinol-ether is broken down, leaving the carbinol itself.

We have prepared highly concentrated F_2 solutions which were evaporated to dryness yielding a waxy yellowish solid which could be crystallized from methanol. The elementary analysis of these crystals was found to correspond with the formula of the carbinol with the exception that the nitrogen content was only half as great. The latter finding was anticipated in view of the prolonged alkali treatment which was noted to liberate ammonia, presumably from hydrolysis of the amide. The elementary analyses of our product obtained from urine and the theoretical values of the carbinol of N-methyl nicotinic acid, are as follows:

	N	*C*	*H*
Product from urine	9.7	58.1	7.2
N-methyl nicotinic acid carbinol	9.1	54.0	6.0

In conclusion we feel that the complete structure of the F_2 precursor is not yet established, although it appears certain that it is a derivative of N-methyl nicotinamide. The highly fluorescent compound F_2 formed from this precursor on treatment with alkali and butanol appears to be a butyl ether of N-methyl nicotinamide α-carbinol.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLIFIED LYOPHIL APPARATUS

The lyophil apparatus described here is a compact and efficient piece of equipment which has proved very satisfactory for small-scale laboratory work. As shown in Fig. 1, the diffusion path of water vapor is short and the cross sectional area is large. The outer jacket has one small opening (A) at the top for evacuating the inner chamber and four openings (B) in the lower portion to which drying flasks are attached. These openings are made with standard taper 34/45 short female ground glass joints. The apparatus in Fig. 1 shows three joints on the side and one at the bottom. The dimensions given here are large enough to accommodate four flasks instead of three on the side if desired. There may also be some advantage in having the joints come off at a downward angle.

The flasks used are pear-shaped in order to facilitate removal of dried material. They are fitted with 34/45 male short joints. The joints are sealed with a film of stopcock grease. The condensing surface (C) is tapered in order to permit accumulation of a greater volume of ice. The apparatus as described in Fig. 1 will hold about 400 ml of ice on the condensing surface.

For operation, the condenser cone is filled with a freezing mixture of dry ice and ethyl cellosolve. The drying flasks are then filled to about 25 per cent. of their capacity with the solution to be dried and are placed in a dry ice freezing mixture. In order to obtain an even layer of material on the walls, the flask is held at an angle and rotated until all the material has frozen solid. When all the flasks are prepared, they are connected to the condenser and the assembly is evacuated. It is convenient to stopper unused openings of the condenser with sealed-off standard tapers which may also be used for drying small samples of material. The temperature inside the flasks depends upon the rate of evaporation, and under the

described conditions is well below freezing until all the water has been removed. The rate of evaporation may be increased by blowing a current of air over the flasks or immersing them in cold water. Materials

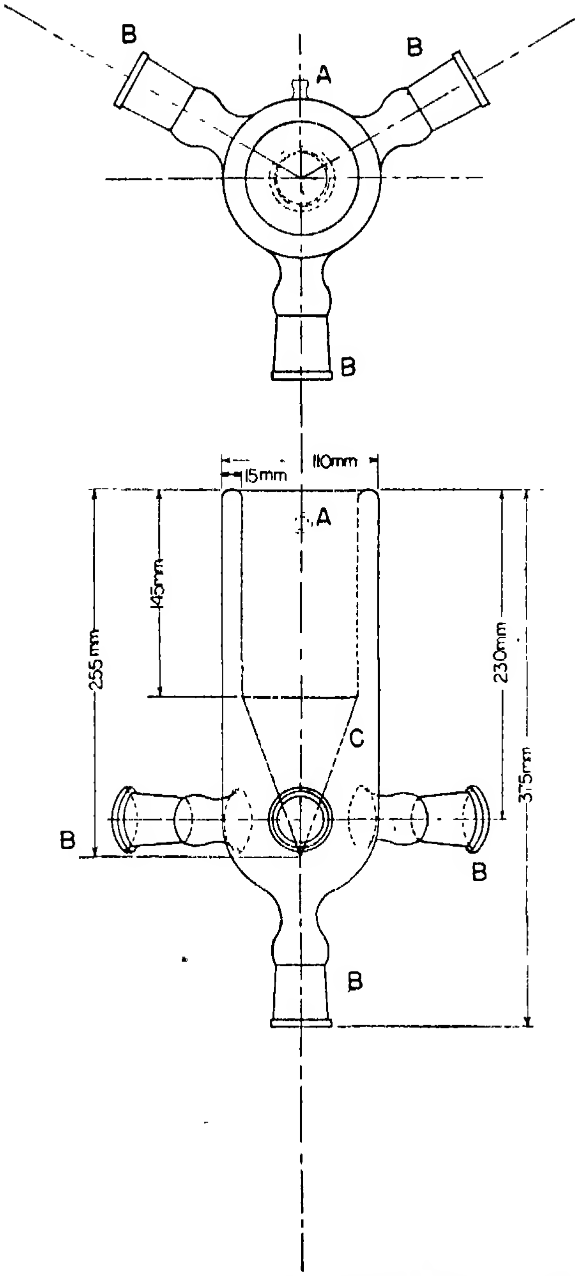

FIG. 1 Diagram of lyophil apparatus showing side and cross section views.

being dried from very dilute solutions have a tendency to be carried out of the flask with the current of water vapor; this may be prevented without causing any appreciable decrease in evaporation by placing a gauze screen over the opening of the flask.

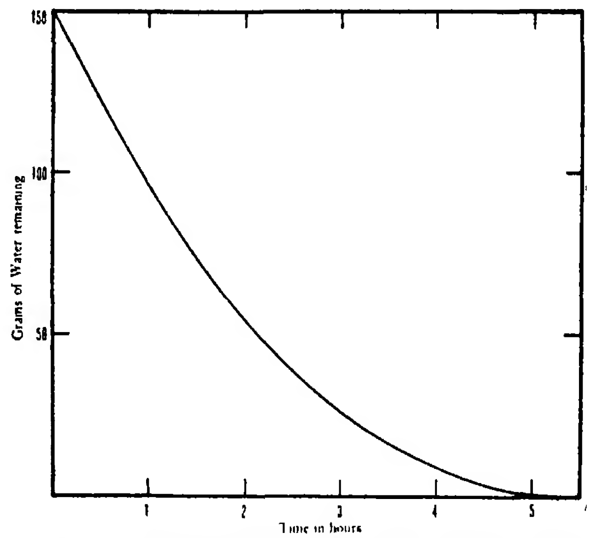

FIG. 2. Amount of water remaining in flasks, plotted against time.

Fig. 2 shows the amount of water remaining as a function of time for 150 gms of distilled water distributed equally among three 200 ml flasks. Complete dryness was achieved in about five hours. The decrease in rate at the end is mainly due to decrease in surface of the subliming ice. Water is evaporated from protein solutions at a comparable rate, depending to some extent on the hygroscopic nature of the material.

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BOOKS RECEIVED

BOWERMAN, MARY L. *The Flowering Plants and Ferns of Mount Diablo, California. Their Distribution and Association into Plant Communities.* Illustrated. Pp. xi + 290. The Gillick Press. $3.75.

CARLISLE, NORMAN V. and FRANK B. LATHAM. *Miracles Ahead. Better Living in the Postwar World.* Pp. xi + 288. Macmillan. $2.75.

FEJOS, PAUL. *Archeological Explorations in the Cordillera Vilcabamba, Southeastern Peru.* Illustrated. Pp. 75. Viking Fund. $3.50.

FENTON, ALFRED and S. W. CLARK. *The Use of Sulphur in the Control of Truck Crop and Cane Fruit Insects and Diseases.* Pp. 85. Texas Gulf Sulphur Company.

GAMOW, G. *Mr. Tompkins Explores the Atom.* Illustrated. Pp. 97. The Macmillan Company. $2.00.

GLASSER, OTTO, EDITH H. QUIMBY, LAURISTON S. TAYLOR and J. L. WEATHERWAX. *Physical Foundations of Radiology.* Illustrated. Pp. x + 426. Paul B. Hoeber, Inc. $5.00.

LINDER, FORREST E. and ROBERT D. GROVE. *Vital Statistics Rates in the United States, 1900–1940.* Pp. vii + 1051. U. S. Government Printing Office. $1.75.

LOBECK, A. K. and WENTWORTH J. TELLINGTON. *Military Maps and Air Photographs.* Illustrated. Pp. x + 256. McGraw-Hill Book Company. $3.50.

NEWMAN, STANLEY. *Yokuts Language of California.* Pp. 247. Viking Fund. $2.50.

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NEW VOLCANOES AND A NEW MOUNTAIN RANGE

By Professor Emeritus WILLIAM H. HOBBS

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In Michoacan province, some two hundred miles due west of the city of Mexico, a volcano was born above a cornfield on February 20, 1943, is already more than 1,500 feet in altitude and is still in a lusty growth. It has been christened *El Parícutin.* The event has figured in world news, and the volcano has been visited by throngs of tourists from the city of Mexico. Already an account of this unusual event has been printed in Science (December 10, 1943) and the occurrence has been pronounced unique in history.

What is so unusual is the birth and growth of a volcanic mountain *away from other volcanoes,* for scores of such mountains have been observed as they have been born upon the flanks of giant volcanoes, such as Etna, and phenomena in all respects comparable to those observed at Parícutin are therefore familiar to volcanologists.

As I shall show, the birth of a volcano like Parícutin, which is some tens of miles distant from other volcanoes, is not unique. Below are listed seven such births recorded in literature, all from the Christian era,[1] and there must have been others which are not of record:

New Volcanoes (in Order of Their Birthdays)

Monte Nuovo (New Mountain), September 29, 1538. Bay of Naples. 440 feet high. Description by Lyell in "Principles of Geology," Vol. 1, pp. 607–619, on the basis of accounts by contemporary observers. Important gun position in the shelling of Naples, 1943.

Jorullo. September 28, 1759. Province of Michoacan, Mexico. 1,600 feet high. Rose above the plain of Malpais. Described by v. Humboldt in *Cosmos.* Fumerole action as late as 1906.

Izalco. February 23, 1769. San Salvador. 1,900 feet

[1] Strabo in his "Geography" has reported two earlier births, that of Madane during the third century B.C. and a submarine eruption in 196 B.C., both in the Aegean. Many submarine eruptions in new localities are of record, the best known that of Nwöe Island (New Island), thirty miles off Cape Reykianes, Iceland, in May, 1783; and Graham Island between Sicily and Tunisia, July, 1831. Unless eruption is long continued such islands are cut away by the waves and are subsequently marked only by shoals.

high. Thrown up in a region used by farmers and herders of cattle. Important later eruptions in 1798, 1803, 1856, 1869, 1873. Still very active with latest eruptions in 1927 and 1939. Account by F. de Montessus de Ballore, "Tremblements de terre et éruptions volcaniques au centre-Amerique," Dijon, 1888, pp. 108–110.

El Nuevo (The New One). April 11, 1850. Also called *Volcan Nuevo* and *Cerro Negro*. Near Léon, Nicaragua. 650 feet high. Thrown up on a plain of ancient lava. Described by F. de Montessus de Ballore, *loc. cit.*, pp. 137–138.

Pochutla. 1870. Province of Oaxaca, Mexico. Briefly referred to by Neumayr in "Erdgeschichte," Vol. 1, 1887, p. 245.

Camiguin, July, 1871. Near Catarman Village on Camiguin Island, Philippines. 1,860 feet high. Thrown up over a flat section of the coast during the cruise of the *Challenger*. Described and figured in "*Challenger* Reports, Narrative," Vol. 1, second part, p. 653.

El Parícutin. February 20, 1943. Province of Michoacan, Mexico. 1,500 feet or more in height. Described by Parker D. Trask in SCIENCE of December 10, 1943.

El Parícutin is thus the latest of new volcanoes in a registered list. Five of the seven recorded—El Nuevo, Izalco, Pochutla, Jorullo and El Parícutin—were all (1) born in either Mexico or Central America, (2) during the last two hundred years, and (3) along a line close to and parallel with the Pacific coast. (See map.)

Though the birth of Parícutin is not an isolated example, the birth and growth of a mountain range which is outlined by a number of known new volcanoes is absolutely unique. Evidence of the rising range is not restricted to the existence of a line of new volcanic vents. It includes (1) volcanic activity, (2) seismicity, (3) a rising coastal ridge and (4) an offshore trough.

(1) *Volcanic activity.* Speaking broadly, the age of volcanoes is measured in terms of their stature, increasing mass being as a rule accompanied also by decreasing activity. Old volcanic mountains are large because they are built up from the extruded lavas. The monarchs of the Mexican region—Orizaba, Ixtaccihuatl, Popocatepetl, Ajusco, Toluca, San Andres and Zamora—have summits from 12,000 to 17,000 feet in altitude, and they were built up during the Tertiary age on an east-west line behind a great mountain range. This range was parallel to the coast of the ocean of that time, one that separated North from South America. The rise of the range has now been largely completed, earthquake activity has largely ceased, and the great volcanoes are nearly or quite extinct.

To-day a range is rising parallel to the Pacific Ocean and the five known new volcanoes are ranged at its back in line with many others, all of them young and mostly active.[2] They are for the most part still of moderate size—about a third that of the earlier east-west series near the latitude of Mexico City (see map). Of those volcanoes in the new series of whose birth we have no record, one, Coseguina, was very likely born near the beginning of the nineteenth century; for though the region had been occupied by the Spaniards since the coming of the *Conquistadores* in the early sixteenth century, the eruption of 1835, one of the grandest in volcano history, is the beginning of the known history of the vent. Another active volcano is Colima at the intersection of the new with the old volcano line, but its active history likewise begins early in the nineteenth century. Its latest eruption was in 1941. Beyond Colima to the northwest activity dies out in Solfataric emanations at Guadalahara, inland from Cape Corrientes, and the circum-Pacific volcano belt is next continued in northern California. To the southward the line of volcanoes comes to an end short of Panama with the active vents in Costa Rica, where the line is separated by a wide gap from the volcanoes of Equador. (See map at end.)

(2) *Seismicity.* All the destructive earthquakes of the region during the twentieth century have occurred within the new rising range, the *Sierra Madre del Sur*, at the back of which is the line of new and youthful volcanoes (see map). If all historic earthquakes are taken into account the distribution is found to be the same.[3] Of thirteen lighter earthquakes in Mexico and Central America, yet important enough to be mentioned in dispatches to *The New York Times* during the last five years, all were from within the area of this new mountain belt.

(3) *A rising coastal ridge.* Between the line of active young volcanoes and the coast is a mountain range, the Sierra Madre del Sur. Its seaward slope is steep and marked by wave-cut terraces, a "coastal staircase," bearing witness to the fact that the land has here lately risen from the level of the sea to its present altitude. The "risers" in the staircase measure the jolting uplifts of greater earthquakes, as the "treads" do the work of sea waves during the intervening periods.

(4) *Offshore phenomena.* Offshore from the rising ridge (between Cape Corrientes at the northwest and Panama to the southeast) at distances varying from seventy to one hundred miles, there extends a deep trough in the sea discovered in 1924, which is steeper toward the land and with depths of from 3,000 to 3,500 fathoms (from over three and one half miles). This trough narrows and shallows toward each end,[4]

[2] To avoid confusion they are not entered on the map. They are mainly in Central America. (See map at end.)

[3] F. de Montessus de Ballore, "La Géographie Séismologique," figs. 66 and 67, pp. 385 and 397.

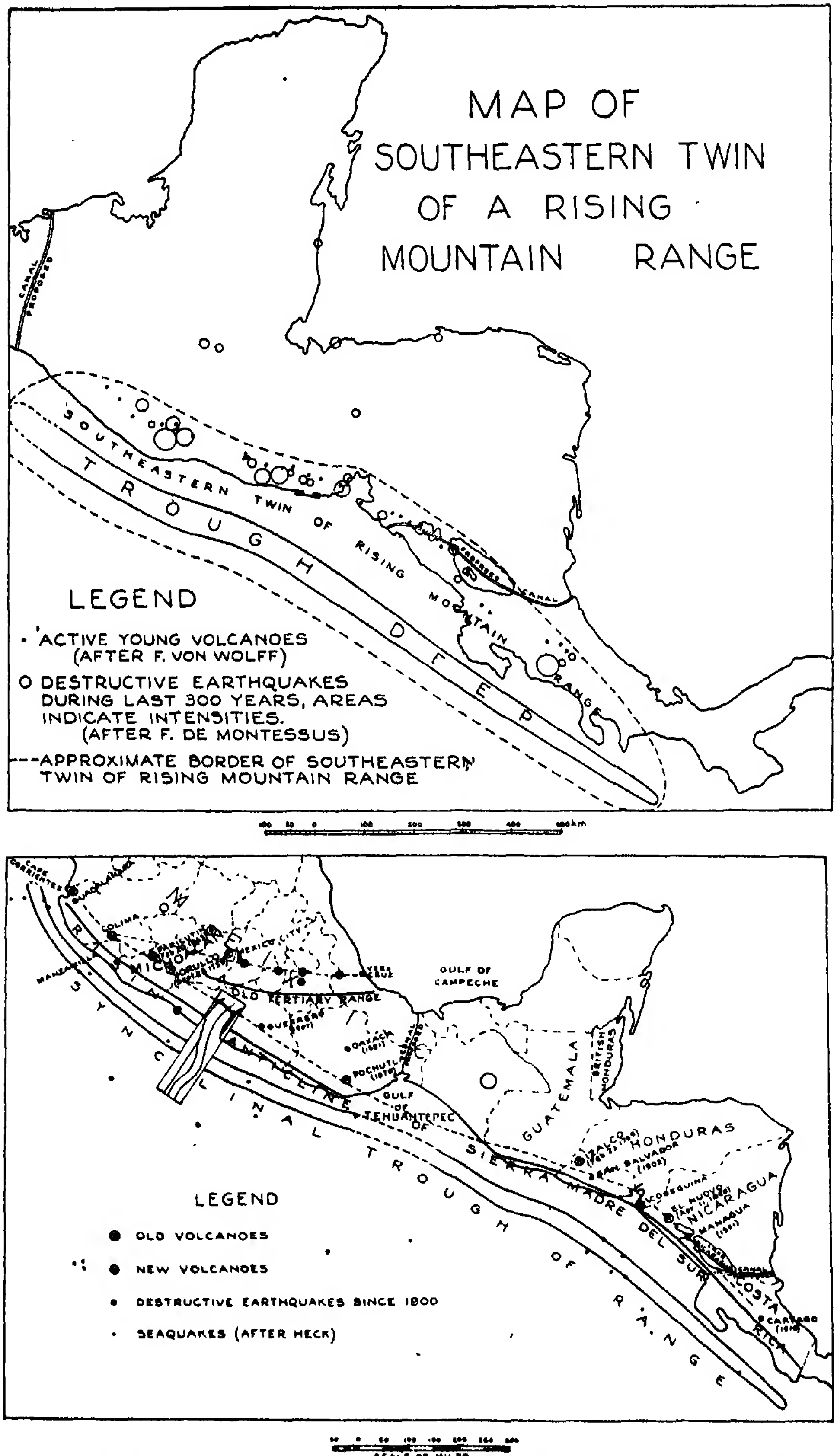

FIG. 1. Map to show a new mountain range rising on the border of the Pacific Ocean.

and appears to be interrupted near the center. The extent of the trough is thus in closest correspondence with that of the rising mountain range on the coast, and it is recognized to be the synclinal portion of the fold in the range, of which the visible portion on shore is the anticline (see sectional inset in map). Such trough-shaped deeps are the locus of seaquakes represented by individual drops of the bottom, each amounting to tens and even hundreds of feet, and these cause seismic sea waves, or tsunamis, which invade the neighboring shores and cause much loss of life and property. In all thirteen such waves have been recorded from this coast, a figure equalled only by that from two other segments of the entire Pacific border (Dutch East Indies and Japan to Kamchatka).[5] That the zone which lies just outside the trough proper also takes some part in the growth of the fold is indicated by the distribution of epicenters upon the map.

The circumscribed area of this rising mountain range (1,500 miles by 200) is probably surpassed for instability, if at all, only by the two other segments of the Pacific coastland which are cited above. Here we are able to note great geological changes brought out of past "eons" and encompassed within centuries. The belt is thus for human activities most dangerous.

It is not without interest that the future second Isthmian Canal, certain to be constructed, should not take its course through Nicaragua, since that route would intersect the rising range and require locks at Managua, already rebuilt seven times after its destruction by earthquakes.[6] As the map shows, the Tehuantepec project is immune from this supreme hazard because of the break in the rising range at the Gulf of Tehuantepec. As the second map shows, the belts of earthquakes and of active volcanoes, as well as the deepening sea trough, are all interrupted at the Isthmus of Tehuantepec. The newly born range is thus shown to be a twin, even if of the Siamese variety.

The next great earthquakes of the twin-range will in all probability occur within the northern portion of the northern twin and in the very near future.

OBITUARY

WILLIAM GEORGE MacCALLUM

DR. MACCALLUM was born in Dunnville, Ontario, and died in Baltimore on February 3, 1944, at the age of 70. He took his B.A. degree at the University of Toronto in 1894, and his M.D. degree at the Johns Hopkins Medical School in 1897. After a year's interneship at the Johns Hopkins Hospital, he became assistant in pathology under Dr. William H. Welch, and successively associate professor of pathology, professor of pathological physiology, a chair created for him in 1908, and in 1917, on the relinquishment of the professorship of pathology by Dr. Welch to assume the directorship of the School of Hygiene and Public Health, MacCallum was chosen his successor. In the interval between the two professorships, MacCallum was professor of pathology at Columbia University from 1909 to 1917.

There was something precocious about MacCallum which marked him out in the medical school. He came to the school exceptionally well prepared for the career in scientific medicine which lay ahead of him. He grew up in an environment of science. His father, Dr. George Alexander MacCallum, besides being a busy general practitioner, was an accomplished naturalist and a collector of birds and Indian relics. His house in Dunnville, in which he had set up a laboratory, was virtually a museum. Later, when he had retired from practice, the elder MacCallum was to write on and collect parasitic worms, concerning which he was an authority. At the University of Toronto, William MacCallum came under the tutelage of Ramsey Wright, an Edinburgh man, zoologist and professor of biology, whose particular field was comparative anatomy. At an early age, therefore, MacCallum was given that bent toward biological science the influence of which is apparent in all his published work.

While still a medical student, MacCallum made a fundamental discovery in biology and medicine. The disease, malaria, was very prevalent in the environs of Baltimore at the close of the nineteenth century. Dr. Osler and his staff became deeply interested in the study of the malarial parasite, which Laveran had discovered in 1880, the life history of which was being actively investigated in Italy and elsewhere at the time. The observation in 1885 that birds harbored a similar parasite (a haematozoon) stimulated the studies at Hopkins, and MacCallum was one of the undergraduates who devoted themselves in the summers of 1896 and 1897 to the investigation of avian malaria. On his return to Dunnville in 1897, and through the study of infected crows, he succeeded in witnessing and in interpreting the phenomenon of flagellation of the parasite, which had baffled all investigators beginning with Laveran. The phenomenon, which had been regarded

[4] N. H. Heck, Pub. 108, U. S. Coast and Geodetic Survey, 1824, pp. 3–17, Fig. 1; *Bul. Seis. Soc. Amer.*, 14: 200, 1924. Also *ibid.*, 16: 182–186, map Fig. 1, 1926.

[5] From a list compiled by N. H. Heck.

[6] The city of San Salvador a little farther to the northwest on the rising range has a similarly disastrous history of seven destructions in three centuries. The latest destruction of Managua was in 1931 when 2,000 persons perished.

as an indication of degeneration, was recognized as part of the sexual cycle of the parasite, in which the flagella function as the male element in the manner of the spermatozoon. Convinced of the significance of the fertilizing process, MacCallum predicted its occurrence in human malaria and actually observed it there a few months later on his return to Baltimore.

At the end of the nineteenth century, the thyroid and parathyroid glands were under study, both surgically and experimentally. The fact had been observed that the condition called tetany—twitchings, quiverings and vibrations of the muscles—followed sometimes on the extirpation of these glands. It could be shown that the symptoms arose from the loss of the parathyroids, and it was thought that they arose from a poison-toxin generated in the body, the neutralization of which was a function of these glands. MacCallum and his associates devoted themselves to an investigation of the problem and, in a research extending over several years and through a series of ingenious and convincing experiments, determined that the hyperexcitability of the nervous system, the immediate cause of the symptoms, arose from a deficiency of calcium and could be abolished by injections of that substance. The parathyroids, therefore, were shown to exercise a special influence over the calcium metabolism of the body.

MacCallum was a teacher who attracted many advanced pupils to his laboratory, students looking forward often to academic careers in pathology and in clinical medicine. His attitude toward pathology was a broad one. As early as 1905, he developed at the medical school practical courses in pathological physiology, an innovation the purpose of which was to bridge a gap between pathological anatomy and the clinical subjects. As pathological anatomy deals chiefly with the end results of disease, he aimed by experimental means to reproduce in animals pathological conditions which could be observed directly by the senses and studied through the use of every possible instrument of precision, in the same way as the physiologist investigates the normal functions of the tissues and organs.

MacCallum was the author of an original and admirable text-book of pathology, which reflects his point of view and sets forth his methods of teaching. Published first in 1916, it has gone through seven editions. The plan he adopted was that of following the effects of the various causes that disturb the natural functions and produce the gross and microscopical changes in the tissues and organs, the basis of disease and the resulting physical and chemical changes which interrupt life. Since, therefore, pathology accompanies and even is the foundation of all clinical phenomena, he sought to consider the two sets of occurrences together.

The diseases of other countries and other climes than Europe and America had a fascination for MacCallum. He made three journeys to the South Seas and the Far East, visiting Australasia, the Dutch Indies, including Bali, Borneo, Singapore, Siam, Manila, China, Japan, the Celebes, Saigon and Ankor, Rangoon, Calcutta and Bombay. While he observed these distant countries with the eager eye of the tourist, he was attracted to the hospitals, where he was warmly received and where the facilities of the pathological laboratories were placed at his disposal. He performed many autopsies, collected many pathological specimens, which rich booty he brought back with him to Baltimore, where it served for study and for instruction. In Jamaica, he investigated an epidemic of alastrim—a mild form of smallpox—which provided material for a monograph on that interesting disease. During World War I, he investigated the pneumonia which prevailed in the Army camps in the winter of 1917–1918, the results of which were also brought together in a monograph.

Those who knew MacCallum well were impressed with his strong individuality and his delightful personality, and came to know something of the philosophy of his professional life. In the seventh edition of his pathology, published not long before his last illness, he expressed the latter in a characteristic way: "The advances in medicine and related sciences have again been very great since the last revision of this book four years ago, but it still reminds us of Goethe's statement that 'it is only when we know very little about a subject that we are quite sure; and with knowledge doubt grows.' We must not be dogmatic, for it seems that before us paths lead into a dark forest of mystery, and it is only when we shall have followed them into outer light that we can feel that we have cleared away our doubts."

SIMON FLEXNER

RECENT DEATHS

DR. ROBERT ANTHONY HATCHER, until his retirement with the title emeritus in 1935 professor of pharmacology at the Cornell University Medical College, has died at the age of seventy-six years. He had been connected with the college since 1904, when he was appointed instructor of pharmacology.

HENRY LLOYD SMYTH, professor of mining and metallurgy emeritus of Harvard University, died on April 1 at the age of eighty-two years.

LEWIS W. WATERS, vice-president in charge of research and development and of scientific relations for the General Foods Corporation, died on March 31 at the age of fifty-five years.

HENRY C. RAVEN, curator of comparative anatomy at the American Museum of Natural History, associate

in zoology at Columbia University, died on April 6 in his fifty-fifth year.

DR. WARREN TAYLOR VAUGHAN, of Richmond, Va., specialist in the treatment of allergic diseases, died on April 2. He was fifty-one years old.

GEORGE ALEXANDER ORROK, consulting engineer, from 1898 to 1916 mechanical engineer of the New York Edison Company, known for his work on power plant engineering, died on April 7 at the age of seventy-seven years.

ARNE FISHER, for twenty-four years mathematician of the Western Union Telegraph Company in New York, died on April 8. He was fifty-seven years old.

SIR CHARLES VERNON BOYS, physicist of Andover, England, died on March 31. He was eighty-nine years old.

SCIENTIFIC EVENTS

THE LENINGRAD CENTER FOR SCIENTIFIC WORKERS

THE blockade of Leningrad temporarily interrupted the work of the Leningrad Center for Scientific Workers, of which Professor L. Veriga, doctor of physics and mathematics, is chairman. Its work is described in the *Information Bulletin* of the Embassy of the USSR as follows:

Only in the spring of 1942 were the 367 scientific workers who remained in the city able to renew the activities of the center, which naturally adapted its efforts to the requirements of the front and of the beleaguered city.

Six sections began work immediately, and 17 sections were functioning by the summer of 1943. Those working in the realm of agriculture took up the problem of rationalizing vegetable gardening. Their conclusions led to two important decisions by the Leningrad Municipal Soviet—on the application of quick crop methods in potato growing and the adaptation of a new bacteriological and nitrogenous fertilizer.

A number of popular booklets on these subjects were published, and several consultation stations for aid to gardeners organized. Lectures advocating the adaptation of new agro-technical methods were held at all state farms in the Leningrad zone, and 600 talks were made to agricultural workers. Winter gardens and experimental hothouses were a part of the program.

The section on mechanical engineering devoted itself to the problem of utilizing damaged and worn machines and equipment. Its members came to the aid of the Leningrad power stations and assisted in their reconstruction. Much work was done on new and vital problems in the field of industrial chemistry. The entire body of scientific workers discussed an important paper on "Ways and Means of Keeping the City Clean in the Winter of 1942–43." Many suggestions were made which greatly facilitated this task.

A section on inventions examined all proposals for strengthening the city's defense and improving the municipal economy. The food section concentrated on the problem of extending and utilizing fully the food resources of Leningrad and of vitaminizing the rations.

During the first half of 1943, workers in the literary and historical sections held six sessions devoted to the great masters of Russian literature—Lomonosov, Pushkin, Belinsky, Gorky, Derzhavin, Chernishevsky and Lermontov. A voluminous collection of themes relating to the present war was published.

The scientific workers of Leningrad have renewed their traditional work with the Baltic Fleet, delivering lectures on the most varied topics to the different naval units. During the past six months over a thousand such lectures have been given on board ships and at naval hospitals.

Many who had prepared themes were unable to receive their degrees because of the evacuation of universities and scientific institutes; nevertheless, work on themes continued and numerous papers have been completed during the war. A year ago a rest home was opened for scientific workers.

THE NATIONAL FOUNDATION FOR INFANTILE PARALYSIS

THE fifth annual report of the National Foundation for Infantile Paralysis has been made public. It shows that during the fiscal year ended September 30, 1943, grants and appropriations were made amounting to $1,278,836 in five main categories—virus research, research on after-effects, education, medical publications, and epidemics and public health. The local chapters which provide care for poliomyelitis patients in their areas receive half the funds raised each January from the celebrations of President Roosevelt's birthday. General administrative expenses for the year amounted to $84,970.

The sum of $107,000 has been spent for the training of Kenny technicians at the University of Minnesota alone, where the evaluation of the method was first undertaken under the auspices of the foundation. Since the first course in the method was given there in March, 1942, more than nine hundred physicians, nurses and technicians have been trained. Other centers have been opened at institutions in California, Illinois, Indiana, Georgia, Pennsylvania and New York. Grants to these institutions amount to $140,000 to date.

In all more than $500,000 has been spent in testing and evaluating the Kenny method and in training. Recently a five-year grant of $175,000 was made to the University of Minnesota for the purpose of studying the physiological problems concerned with the

mechanism of the disease process and methods of treatment.

THE PROPOSED TRAINING OF FOREIGN ENGINEERS IN THE UNITED STATES

The General Engineering Staff of the Foreign Economic Administration has, according to *The New York Times,* adopted a report prepared by Edgar J. Gealy, head industrial engineer, in regard to a plan to train in American engineering colleges after the war from 3,000 to 4,000 foreign technical graduates from Europe and Asia so that they can return after eighteen months of study to help in the reconstruction of their own lands. Students will be selected by the foreign governments with the advice of educational leaders of the United States. All students will receive practical working experience in industry for a third of the course. At college they will be under the direct supervision of the college authorities.

Courses have been developed or are under preparation at the Carnegie Institute of Technology, the Colorado School of Mines, the Illinois Institute of Technology, the Massachusetts Institute of Technology, Northwestern University, Pennsylvania State College, the Philadelphia Textile Institute, Purdue University, the University of Detroit, the University of Illinois, the University of North Carolina, the University of Michigan, the University of Utah, the University of Wisconsin and Union College.

Expenses are estimated at $3,600 for each student. Most of the money will be provided by the foreign countries concerned. The Federal Government proposes, however, to contribute an unspecified percentage.

In addition to the training of foreign students, the colleges will provide training for technical graduates of this country who wish to prepare for foreign service. Because of the complete destruction of many engineering centers in Europe, it will be necessary for the United States to assist in rebuilding the foreign industrial systems. It is expected that to a considerable degree foreign industries will depend upon American engineers and that from 5,000 to 10,000 American students will be trained for foreign service.

THE NUTRITION FOUNDATION

Grants amounting to $131,000 for research in nutrition were made by the Board of Trustees of the Nutrition Foundation, Inc., at a recent meeting held in New York. They are distributed among twenty-three colleges and universities in the United States and Canada and include the renewal of grants for thirty-one research projects already in progress and three additional grants for studies at Harvard, Yale and Cornell Universities.

George A. Sloan, president of the foundation, stated that action had been taken looking towards assisting in so far as possible in the post-war placement of personnel trained in research.

Dr. C. G. King, scientific director, made the following statement:

Research projects having the greatest value thus far were "those dealing with army rations, human protein requirements, maternal and infant nutrition, dental caries and human vitamin requirements.

New grants authorized at the meeting were as follows:

Harvard University: For training physicians in the human and public health aspects of nutrition.

Yale University: In support of studies on maternal and infant nutrition, based on carefully controlled nutrient intakes of primates—other animals having been found not so satisfactory for the study of numerous human problems such as dental caries, physical deformities or functional impairment.

Cornell University: For study of the biochemical mechanism of converting starches and sugar into fat.

The colleges and universities receiving grants include:

Columbia University; Cornell University; Duke University; Harvard University; Johns Hopkins University; Massachusetts State College; New York University; Northwestern University; Oklahoma Experiment Station; Ontario Agricultural College; Oregon State College; Purdue University; Stanford University; University of California; University of Cincinnati; University of Illinois; University of Minnesota; University of Rochester; University of Toronto; University of Wisconsin; Vanderbilt University and Yale University.

NEW FELLOWS OF THE ROYAL SOCIETY

The Royal Society, London, elected on March 16 the following fellows:

Brigadier Ralph Alger Bagnold, explorer.
Ronald Percy Bell, fellow of Balliol College, Oxford.
Cecil Reginald Burch, research physicist, University of Bristol.
Subrahmanyan Chandrasekhar, astronomy, associate professor, University of Chicago, formerly fellow of Trinity College, Cambridge.
George Edward Raven Deacon, member, scientific staff of Discovery Committee, Colonial Office.
Sir Jack Cecil Drummond, professor of biochemistry, University College, London, and chief scientific adviser to the Ministry of Food.
Alexander Thomas Glenny, immunologist, Wellcome Physiological Research Laboratories, Beckenham.
Ronald George Hatton, director, Fruit Research Station, E. Malling.
Robert Downs Haworth, professor of chemistry, University of Sheffield.
William Ogilvy Kermack, research chemist, Royal College of Physicians, Edinburgh.

Franklin Kidd, superintendent, Low Temperature Research Station, University of Cambridge.

Bryan Austin McSwiney, professor of physiology, St. Thomas's Hospital, University of London.

Guy Frederic Marrian, professor of medical chemistry, University of Edinburgh.

Michael Polanyi, professor of physical chemistry, University of Manchester.

Alec Sand, comparative physiologist, Marine Biological Station, Plymouth.

Sir William Arthur Stanier, chief mechanical engineer, London Midland and Scottish Railway.

Cyril James Stubblefield, senior geologist, Geological Survey of Great Britain.

Oscar Werner Tiegs, zoologist, University of Melbourne, Australia.

Hendrik Johannes Van Der Bijl, research physicist, director of war supply, Union of South Africa, vice-chancellor, Pretoria University.

John Henry Constantine Whitehead, university lecturer and fellow of Balliol College, Oxford.

SCIENTIFIC NOTES AND NEWS

DR. ALEXANDER LIPSCHUTZ, director of the department of experimental medicine of the Chilean National Health Service at Santiago, has been selected the recipient of the second Charles L. Mayer $2,000 prize, which is administered by the National Science Fund of the National Academy of Sciences, of which Dr. William J. Robbins, director of the New York Botanical Garden, is chairman. The award was offered for "an outstanding contribution made in 1943 to present-day knowledge of factors affecting the growth of animal cells, with particular reference to human cancer." The advisory committee consisted of Dr. R. R. Williams, chemical director of the Bell Telephone Laboratories; Dr. Alan Gregg, director for the medical sciences of the Rockefeller Foundation, and Dr. Peyton Rous, of the Rockefeller Institute for Medical Research. The formal presentation of the award will be made late this month at the annual meeting in Washington, D. C., of the National Academy of Sciences.

THE American Ambassador to Great Britain, John G. Winant, acting in behalf of the American Geographical Society of New York, at a ceremony in London on March 31 presented the Charles P. Daly Medal to Sir Halford Mackinder, the English geographer and statesman, and the Cullum Geographical Medal to Arthur R. Hinks, F.R.S., secretary of the Royal Geographical Society and Gresham lecturer in astronomy.

DR. WALTER THOMAS, professor of plant nutrition at the Pennsylvania State College, has been awarded the Charles Reed Barnes honorary life membership for 1943 in the American Society of Plant Physiologists "for outstanding researches in the mineral nutrition of plants."

DR. WILLIS R. WHITNEY, honorary vice-president of the General Electric Company and first director of its research laboratory, has been elected an honorary member of the Electrochemical Society. The certificate of honorary membership will be conferred on him at the Milwaukee meeting.

THE Dye Works of E. I. du Pont de Nemours and Company at Deepwater Point, N. J., has been named the "Chambers Works" in honor of Dr. Arthur D. Chambers, manager of the Dyestuffs Division of the Department of Organic Chemistry. He is retiring after serving the company forty-seven years. At a dinner given in his honor on April 4 he was presented with a watch by the staff of the Organic Chemicals Department at Wilmington.

H. HAROLD HUME, provost of the College of Agriculture of the University of Florida, has received from Swarthmore College the Arthur Hoyt Scott Garden and Horticulture Award for 1944. This award is $1,000 and a gold medal is given yearly "to that individual, organization or agency which, in the opinion of the committee, has made an outstanding contribution to the science and art of gardening."

DR. BRADFORD WILLARD, since 1939 head of the department of geology at Lehigh University, was chosen at the York meeting president-elect of the Pennsylvania Academy of Sciences.

DEAN A. W. BRYAN, of the Dental College of the University of Iowa, has been elected president of the American Association of Dental Schools.

MRS. ELEANOR BROWN MERRILL, executive director of the National Society for the Prevention of Blindness, has been elected president of the National Health Council for 1944 to succeed Dr. George S. Stevenson, medical director of the National Committee for Mental Hygiene.

DR. HARRY BENJAMIN VAN DYKE, head of the division of pharmacology of the Squibb Institute for Medical Research at New Brunswick, N. J., has been appointed professor of pharmacology at Columbia University and executive officer of the department. He succeeds Professor Charles C. Lieb, who retires to become Hosack professor of pharmacology, emeritus.

ALDEN R. WINTER, on leave from the Ohio State University, will serve for nine months as research associate professor of poultry husbandry at the Iowa State College. He will make a study of the bacteriological and pasteurization problems of egg products.

DR. CHARLES E. DECKER, professor of paleontology

and head of the department of the University of Oklahoma, and J. Reed Nielsen, professor of physics, have been elected to research professorships. These chairs were established at a meeting of the Board of Regents on November 12. They are awarded to members of the faculty who shall have made distinguished contribution to knowledge and who have demonstrated vigorous leadership in the field. Each will receive a salary of $5,000 a year for a ten-months period. Nominations are made to the Graduate Council by the dean of the Graduate College. On the unanimous vote of the council the dean submits a list to the president for approval and the subsequent approval of the Board of Regents. It is provided that "the tenure of the professor shall be until he reaches the statutory retirement age established by the regents."

Dr. Alfred Le Roy Johnson, orthodontist, professor of clinical dentistry, has been appointed administrative officer of the new School of Dental Medicine of Harvard University and associate dean of the faculty of medicine. The School of Dental Medicine on March 31 assumed responsibility for all dental education and research at the university. It succeeds the Harvard Dental School, the oldest university dental school in the United States, which was founded in 1867 and which held its final commencement last month. Its quarters will be rearranged for the new school.

Walter Fitzgerald, senior lecturer in geography at the University of Manchester, has been appointed professor of geography in succession to Professor H. J. Fleure, who will retire in September.

Dr. George K. Strode, since 1938 associate director of the International Health Division of the Rockefeller Foundation, has been appointed director, effective on September 1. He will succeed Dr. Wilbur A. Sawyer, who plans to retire.

Dr. Alfred M. Lucas has resigned as associate professor of zoology at Iowa State College to become cytopathologist at the U. S. Regional Poultry Research Laboratory, East Lansing, Mich.

Dr. V. N. Krivobok, recently chief metallurgist of Lockheed Aircraft Corporation, has joined the development and research division of the International Nickel Company in New York. Dr. Krivobok was from 1924 to 1940 connected with the Carnegie Institute of Technology, Pittsburgh, becoming professor of metallurgy there in 1932.

Dr. R. E. Stradling has been appointed to the newly established position of chief scientific adviser to the British Ministry of Works. He will retain his post of chief adviser in research and experiments to the Ministry of Home Security.

Sir Henry Dale, president of the Royal Society, London, has accepted an invitation of the British Penicillin Committee to be their chairman. The other members of the committee are Dr. V. D. Allison, Ministry of Health; Lieutenant-Colonel H. J. Bensted, Army Medical Department, War Office; Professor R. V. Christie, Medical Research Council; Dr. A. N. Drury, Medical Research Council; Professor A. Fleming, St. Mary's Hospital; Professor H. W. Florey, School of Pathology, Oxford; Dr. C. R. Harington, Medical Research Council; Professor I. M. Heilbron, professor of organic chemistry, Imperial College of Science and Technology, and scientific adviser to the Ministry of Production; Professor R. P. Linstead, department director of scientific research, Ministry of Supply; Professor H. Raistrick, London School of Hygiene; Professor Sir Robert Robinson, Dyson Perrins Laboratory, Oxford; and Colonel Sir Russell Wilkinson, military medical adviser, Ministry of Supply, together with representatives of firms engaged in the production of penicillin.

Dr. E. DeGolyer, who recently resigned from the Petroleum Reserves Corps, after investigating for the Government the oil resources in Saudi Arabia, has accepted an invitation from the Brazilian Government to explore petroleum potentialities there.

Arthur Phillips, professor of metallurgy at Yale University, will leave in May to spend three months in São Paulo, Brazil, where he will deliver a series of lectures on non ferrous metallurgy. He is one of four United States authorities in metallurgy to lecture in the series established last year at the Escola Politecnica of the University of São Paulo and at the Instituto de Pesquisas Tecnologicas, also of São Paulo. The project is jointly financed through the office of the Coordinator of Inter-American Affairs and the University of São Paulo, and is administered by the Stevens Institute of Technology. Mr. Phillips has been invited to visit many of the metal industries in order to gain an intimate knowledge of the problems facing the metal producers of Brazil.

Dr. Selig Hecht, of the Laboratory Biophysics of Columbia University, gave on March 28 a lecture on "Energy and Vision" under the auspices of the Harvard University Chapter of the Society of the Sigma Xi.

The third Edwin R. Kretschmer Memorial Lecture of the Institute of Medicine of Chicago will be delivered at the Palmer House on Friday evening, April 28, by Dr. Russell L. Haden, of the Cleveland Clinic, on "The Varying Clinical Picture of Leukemia."

The Gehrmann Lectures for 1943–1944 will be delivered at the University of Illinois College of Medicine

on May 17, 18 and 19 by Dr. Harold S. Diehl, dean of the Medical Sciences at the University of Minnesota. He will speak on the cause, epidemiology, prevention and treatment of the common cold, and on some recent American epidemics.

DR. EARL A. EVANS, JR., professor of biochemistry at the University of Chicago, will deliver the seventh Harvey Society Lecture of the current series at the New York Academy of Medicine on April 20. He will speak on "Carbon Dioxide Fixation in Animal Tissues."

DR. COLIN M. MACLEOD, professor of bacteriology at the New York University College of Medicine, delivered the Laity Lecture at the New York Academy of Medicine on March 23. His subject was "The Past, Present and Future of Chemotherapy."

DR. LEON H. LEONIAN, of West Virginia University, spoke on March 22 to the Eastern Missouri Branch of the Society of American Bacteriologists and the department of botany of Washington University on the "Comparative Value of the Different Test Organisms in Microbiological Assay of B Vitamins."

THE Medical Branch at Galveston of the University of Texas has established an annual lectureship under the auspices of the Phi Beta Pi Medical Fraternity. The first lecture in the series was given on March 25 by Dr. Theophilus S. Painter, research professor of zoology at the University of Texas. It was entitled "A Cytologist Looks Forward."

THE Council of the Association of Southeastern Biologists has voted not to hold it annual meeting this spring due to the war emergency. It was decided also that the incumbent officers would serve until the next annual meeting. These officers are: *President,* Mary Stuart MacDougall; *President-elect,* Dr. James T. Penney; *Vice-president,* Dr. Reed O. Christenson, and *Secretary-Treasurer,* Dr. Martin D. Young.

THE American Home Economics Association will hold its annual meeting from June 20 to 23 in Chicago, with headquarters at the Stevens Hotel. The program will be devoted to a discussion of "The Family in the World of To-morrow." A Youth Conference for members of the home economics student clubs affiliated with the association will be held during the same week.

ACCORDING to the daily press, Louis Bamberger, founder of L. Bamberger and Company, the Newark department store, who died on March 11, left his residuary estate to the Institute for Advanced Study at Princeton, N. J., which he founded with his sister, Mrs. Felix Fuld, in 1930 with a gift of $5,000,000. It is estimated that the residuary estate will amount to over $1,000,000.

THE New York Medical College has received a grant of $30,000 from the Anaconda Wire and Cable Company for research in industrial medicine, arising out of problems incident to the manufacture of its products. The study will determine whether occupational hazards exist and will develop means of giving adequate protection to the workers if necessary. The project is under the direction of Dr. Lindsley F. Cocheu, director of the department of public health and industrial medicine, assisted by Dr. Linn J. Boyd, director of the department of medicine, and Dr. Francis J. Speer, director of the laboratories of clinical pathology.

THE Pittsfield Building in Chicago and the Loop site it occupies, together with 10,000 shares of Marshall Field and Company Series 1–6 per cent. preferred stock, have been transferred to the ownership of the Chicago Natural History Museum (formerly Field Museum) as a gift from Marshall Field, publisher of *The Chicago Sun* and member of the board of trustees of the museum. The contribution is in fulfilment of a pledge made by Marshall Field on September 15 on the occasion of the celebration of the fiftieth anniversary of the museum, when he authorized Stanley Field, president of the museum, to make public his intention to give the museum "certain pieces of property that should produce an income at least equivalent to what his annual contributions have been in recent years."

THE U. S. Weather Bureau will offer twenty full tuition scholarships in the department of meteorology of the College of Engineering of New York University to train women and discharged veterans for positions in Weather Bureau offices in various parts of the United States. Applicants must have had at least two years of college work, including physics and mathematics through calculus. The course at New York University will be similar to that given to Army Air Cadets and Naval Ensigns, and will extend from May 5 to January 10. An intensive one-month refresher course in mathematics and physics is offered to applicants during April. Students who successfully complete the course will be eligible for civil service examinations for positions with a base salary of from $1,800 plus 20 per cent. to $2,000 plus 20 per cent.

THE Ohio State University announces the establishment of the Edward L. Bernays Radio Award of $1,000, a gift from Mr. Bernays, of the Public Relations Counsel, New York, to the Institute for Education by Radio of the university. It is provided that the award shall go to the individual "who makes the outstanding contribution in the year 1944 in the field of radio which furthers democratic understanding, democratic thinking and democratic action by the people of the United States."

DISCUSSION

THE USE OF AN INTERNATIONALLY UNDERSTANDABLE LANGUAGE IN SCIENTIFIC PUBLICATIONS AND IN CONGRESSES

ONE of the main facts impending on the normal development of all branches of scientific life is the utilization of numerous different idioms for the publication of research works. In Europe alone about twenty-five native languages compete in scientific publications; in Asia there are fewer at present, but their number will probably increase in the way of including new populations of that big continent into the circle of cultural progress.

A partial solution for the urgent problem of international linguistic understanding between scientists has been found in the insertion of short summaries written in one of the leading languages giving a résumé of the contribution of the author in his national idiom.

A further step has been made by specialized magazines and by sections in scientific journals which give information in condensed reports about all scientific publications of the world.

In international meetings the question is resolved by translators, who generally give short abstracts—and only rarely complete reports—about the works presented. These mentioned "solutions" represent a valuable contribution to the interchange of scientific problems, but they must be considered as palliative methods. As a matter of fact no "summary" and no "abstract" can reproduce exactly important details of determined reports.

From the point of view of the rationalization of valuable human energy it is obvious that this situation is the origin of an enormous waste of intellectual and material efforts, conditioned by a superfluous repetition of the same experiences and researches in various countries. The progressing intensification and specialization of scientific research work will increasingly complicate the problem of divulgating practical applications of valuable results on a world-wide scale.

There is only one radical remedy susceptible to change this situation described above—the creation of an international language for scientific publications and for research meetings. Everybody knows of the attempts to introduce a universal language. But "Esperanto," the most successful of all, though backed by a high idealistic conception, gave only modest practical results. In my opinion, the proclaimed aim can be realized much sooner if international understanding starts in the field of the scientific research work. Once adapted there the extension of a world-wide understandable idiom to other branches of human life would follow progressively.

As an eventual intermediary language there can be mentioned Latin, one of the so-called living idioms, or an artificial language, such as Esperanto. As a biologist, I am personally more inclined (as certainly also others are), to oppose the introduction of any artificial language rooting in a multitude of native tongues and lacking therefore in the organic development—so well it may be elaborated.

Better founded seems to me the utilization of Latin or of one of the living idioms, specially of the English language. In favor of this thesis the following facts may be remembered: The existence of a complete scientific terminology, the divulgation of the English idiom all over the world and the relative small value of grammatical rules.

As to the use of Latin it may be considered as a favorable fact that this language can not hurt the national feelings of any people.

Naturally each intermediary language can enumerate reasons pro- and contra- its application on an international scale. It seems to be the task of an International Commission, composed of representatives of the theoretic and of the practical science branches, to weigh out the advantages and disadvantages of each of the proposals presented.

If I consider as advisable to present by an intermediary language scientific publications, reports of the activity of scientific societies, discussions on international meetings, I include the right for each participant nation of orientating as before scientific writing in their respective national idioms.

The translation of standard works—as in the chemical branch, "Beilstein, Handbuch der organischen Verbindungen"—remains in charge of this International Commission, which has to be divided into sections corresponding to the various branches of scientific life. Special international agreements have to assure the adequate interpretation of the copyright law. A further task of this institution should be to establish a uniform scientific nomenclature.

The object of the present contribution is to suggest that the American Association for the Advancement of Science may take up this problem as a matter of discussion. The present circumstances seem to favor the elaboration of preliminary bases of an international scientific language, for the moment nears when all human beings can newly contribute to the construction of a better world. No doubt the utilization of an idiom understandable all over the world would represent a valuable contribution of science to the

establishment of better relations between all nations and constitute a real progress of our civilization.

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THE NATURAL SCIENCE SOCIETY OF CHINA[1]

THE following letter, dated January 24, has been addressed to the American Association for the Advancement of Science:

We learned with great admiration and pride the splendid part the members of your Academy have played in the present war against fascism and barbarism. Our country and especially the cultural institutions have suffered deliberate and wanton destructions from the hands of the Japanese fascists during the present invasion. In spite of this, we are endeavoring to do our best to serve our country and the noble cause of our allies with the meager equipments and literature that were left to us. We sincerely believe that science and democracy are indispensable in our modern world, but science without democracy means fascism and Hitlerism and democracy could not function efficiently and smoothly without scientific knowledge and the scientific means of production to satisfy the cultural and material needs of the masses. We further believe that the cooperation and collaboration of the scientific workers of the world will help us to gain a quick victory and will also facilitate the laying down of the foundation of permanent peace immediately after the war. In order to do our modest part towards the goal of international scientific cooperation we have compiled a paper called "Acta Brevia Sinensia" in which the research activities and the recent news of the various institutions of our country are reported at definite intervals, and at the same time we are preparing to issue another paper, the main purpose of which is to print scientific news and abstracts of scientific papers of our allies. In order to make it a success we, therefore, beg your kind cooperation, and hoping you would kindly supply us the scientific news and abstracts of papers of your country.

Enclosed herewith is a copy of a short account of our society and our activities. As we are late comers in the realm of science and technology we should be very thankful if you would kindly favor us with your words of wisdom.

May this letter serve as a messenger boy to bring to you our hearty greetings and warmest congratulations for the patriotic works so wonderfully performed in the present struggle against the enemy of science and humanity.

With New Year's greetings,
CHANG-WANG TU,
(*Secretary for Foreign Relations*)

An account is enclosed giving a list of the activities of the society, which reads:

1. *History and Aims:*

The society was established in 1927 with a view to achieve the following: (*a*) to spread scientific knowledge to the masses; (*b*) to apply scientific and technological knowledge to national reconstruction; (*c*) to promote scientific research; (*d*) to facilitate scientific cooperation.

2. *Organization:*

There are thirteen branch societies established in various districts of free China and three additional ones in Europe and America. The members of the society total 1,800. Under the head office at Chungking there are four committees: (*a*) Committee for General Affairs; (*b*) Committee for Research and Culture; (*c*) Committee for Organization; (*d*) Committee for Social Service.

3. *Activities:*

The following works of importance have been carried out by the society since its establishment:

(*a*) The publication of the *Scientific World*. Twelve volumes have been issued since 1932. This magazine is a very popular scientific journal in China.

(*b*) The organization of scientific expeditions. Since 1937 two scientific expeditions have been sent out by the society to explore the natural resources, to study the physical and bio-geography of provinces such as Sikang, Kansu and Ningsha. The results of these expeditions are contained in the reports published afterwards.

(*c*) The publishing of scientific books concerning the problems of national defense. The following books are already in press: i. "On the Principles of Flight"; ii. "Principles of Aeroplane Construction"; iii. "Explosives"; iv. "Precaution Against Poisonous Gases"; v. "Ballistics." In addition, there are some twenty volumes under preparation.

(*d*) Public lectures and radio talks on science. Public lectures and radio talks on scientific subjects have been given periodically to the public in various cities of China.

(*e*) The publication of "Acta Brevia Sinensia." This paper intends to convey the scientific works done in China to the scientific workers of the democratic world. The society is planning to publish a bulletin to print the scientific news and achievements of our allies with the cooperation of the leading scientific societies of the democratic world.

(*f*) Future projects. The members of the society feel that they should devote more time to the society and the masses, so plans have been drawn accordingly. The more important ones will be carried out as soon as we have the money, and they are: (i) to establish a "Science Museum" and a "Science Library"; (ii) to organize an institute for scientific service; (iii) to publish a journal for original research work, etc.

NATIONAL CENTRAL UNIVERSITY,
SA-PING-PA, CHUNGKING, CHINA

[1] Transmitted by the China Section of the Science, Education and Art Division of The Department of State, March 1, 1944. Translated from the official letter in Chinese.

SOVIET BIOLOGY

THE eulogy of Soviet biology published in a recent issue of SCIENCE[1] did not present a realistic survey of the present situation. The author did not discuss the most significant trend of biological research in the

[1] L. C. Dunn, SCIENCE, January 28, 1944.

U.S.S.R.—the subservience of science to social and political philosophy. It is important that this aspect of Soviet science should be generally known and understood because it is not confined to Russia. It could happen here.

The work of Russian geneticists, plant breeders and cytologists, during the early years of the Soviet régime, deserves the highest praise, as does the Soviet government for providing such generous support for scientific work. About ten years ago the influence of Soviet political philosophy began to appear in biological science, culminating in a public controversy regarding the relative roles of environment and heredity in 1939. Much of this controversy has been published in this country,[2] and a more damning indictment of the new Russian biology would be difficult to imagine. Vavilov, while recognizing the effect of environment on development, emphasized the progress of genetics and the role of heredity in plant breeding. Lysenko, on the other hand, upheld the Lamarckian (in his words "Darwinian") concept of variation, and rejected Mendelian heredity and genetics as a science. He also claimed that "any hereditary properties can be transmitted from one breed to another without the immediate transmission of the chromosomes." His discussion of "vegetative hybrids" resulting from grafting might well have been written in 1800; his views are neither original nor heterodox, but merely archaic.

Lysenko's attitude towards genetics presumably was influenced by his earlier work on vernalization. A winter wheat, which differs from a spring wheat by a single genetic factor, can be grown as a spring wheat if the seed is moistened and chilled for several weeks before planting. This discovery was made in the United States before the Civil War. Vernalization is also said to hasten the maturity of other crops. This technique has been tried in many other countries without sufficient success to warrant commercial utilization, but it has been used extensively in Russia.

Lysenko and his associates seem to have convinced the political authorities that only environmental effects are of value in plant improvement. Since 1939 the Soviet plant-breeding journals have been filled with articles by Lysenko's disciples, but we hear nothing from Vavilov, Karpechenko, Navaschin and the many other able scientists who are responsible for building the foundations for Russia's plant-breeding program. A few examples of the recent plant-breeding methods are typical of the new order. In one case scions of a yellow-fruited tomato variety when grafted on a red-fruited stock are said to produce progeny segregating for fruit color. Dolgusin claims that halves of the same plant, when grown under different environmental conditions and then crossed, produce progeny of increased vigor and fertility. The ovules are supposed to select the pollen grains most favorably affected by the environment. This selective power of the gametes is referred to by Lysenko as "marriage for love."

There are several reasons for the suppression of genetics in the U.S.S.R. A nationalistic attitude is reflected in Polyakov's[2] reference to genetics as a "foreign science." Another factor may have been a reaction to the distortion of genetic principles by the Nazis in their myth of racial superiority. The primary factor, however, appears to have been based upon political philosophy. It is particularly significant that the Lysenko-Vavilov controversy was reviewed by Mitin, head of the Philosophical Institute of the Academy of Science, and that he "more than other commentators" expressed "the attitude of the Soviet government."[2]

Our admiration for the Russian people and the military might of the Soviet Republic should not blind us to the fact that science has not been free in the totalitarian states where science must conform to political philosophy.

KARL SAX

HARVARD UNIVERSITY

NEWTON ON HEAT AS A MODE OF MOTION

In reading lately Query 28 in Newton's "Opticks," I noticed a remark that gives his views on the nature of heat. It was new to me, and perhaps it will be interesting to other physicists. The passage in part is as follows: "A dense fluid can be of no use in explaining the phenomena of Nature, the motion of planets and comets being better explained without it. It serves only to disturb and retard the motions of those great bodies, and make the frame of nature languish: and in the pores of bodies, it serves only to stop the vibrating motions of their parts, wherein their heat and activity consists."

FRANK ALLEN

UNIVERSITY OF MANITOBA

SCIENTIFIC BOOKS

THE PLASMODIOPHORALES

The Plasmodiophorales. By JOHN S. KARLING. ix + 144 pp. 17 plates, 11 text figures. Published by the author. New York. 1942.

THIS book is based upon a "series of lectures presented to graduate and research students of mycology at Columbia University." Accordingly, the author attempts to present all sides of controversial questions

[2] *Science and Society.* A Marxian Quarterly. Summer, 1940.

with extensive references to the works of various investigators in the field. He points out obvious errors and misinterpretations of observations, but in cases of doubt leaves it to the reader to decide what conclusions he should draw from the reported facts. Constantly the author points out where further investigations are necessary before the final decisions can be made. This group of organisms is regarded as consisting of but one family, the Plasmodiophoraceae, with eight or perhaps nine valid genera and twenty-three species, besides possibly four genera doubtfully belonging to this family each with a single species. Four genera that have been ascribed to the group are definitely excluded as are a number of species from the accepted genera. *Woronina* of Family Woroninaceae is discussed, but for the present is left in that family until further cytological studies may cause it to be transferred to the Plasmodiophoraceae.

A chapter is devoted to the cytology of the Plasmodiophorales in comparison with that of various Protozoa. The reported phenomena are so contradictory that it seems unwise to base decisions as to relationship on cytology until there is better agreement as to the presence or absence of "promitosis," "wheel type" of resting nucleus, "saturn" stage, "akaryote" stage, type and location of meiosis, "schizogony," etc. Another chapter is devoted to "Sexuality and Alternation of Generations." Here, again, the disagreements are more pronounced than the agreements. In some species sexual union of cells is unknown; in *Plasmodiophora brassicae*, the longest known and most intensively studied species of the family, sexual union has been reported outside of the host tissues, early after entry into the host and close to the end of the life cycle just before the resting spores are formed. In general the more typical life history in the family is as follows: The resting spore germinates to set free an anteriorly biflagellate heterocont zoospore. This infects the host cell and with or without further cleavage becomes, by growth accompanied with mitotic division of the nuclei, a multinucleate plasmodium. This cleaves into uninucleate segments, each of which is invested with a thin wall and becomes a zoosporangium whose zoospores are similar to, but sometimes smaller than, those produced by the germination of the resting spores. These reinfect other cells of the host and produce plasmodia which eventually cleave into resting spores. Cytogamy and karyogamy are described by some authors between the products of the resting spores, by some between the zoospores emerging from the zoosporangia, while karyogamy followed by meiosis is claimed by still others as occurring in the nearly mature plasmodium just before it breaks up into the resting spores.

Chapter IV takes up the "Classification and Description of Species." In the main the author follows Schroeter's arrangement with full recognition of its faults and artificiality. Until satisfactory life history studies have been completed in all the genera these undesirable conditions must remain. The first genus to be described was *Plasmodiophora* by Woronin, in 1877, and the last genus to be proposed was *Octomyxa* in 1939. With the exception of *Ligniera* and of *Polymyxa* all known species of the family cause hypertrophy and often hyperplasy of the host tissues. With the exception of *Octomyxa achlyae*, which is parasitic in *Achlya glomerata*, and of *Sorodiscus karlingii*, parasitic in *Chara*, the species are found in the roots and stems of vascular plants. The production of zoosporangia in the life history of the organism has been demonstrated for *Plasmodiophora, Octomyxa, Sorosphaera, Spongospora, Ligniera* and *Polymyxa*. It has not been recorded in *Tetramyxa, Sorodiscus* and in *Membranosorus* whose status as an independent genus is uncertain. Indeed, according to Palm and Burke, the validity of many of these genera is very doubtful. Their distinction is based on the manner of clustering or separation of the resting spores at maturity, and this appears to vary considerably in the same species.

All the genera and most of the species are illustrated by redrawings from the original publications, as are also the doubtful and the excluded genera.

Chapter V discusses the "Phylogeny and Relationship of the Plasmodiophorales," especially with reference to their possible relationship to the Myxomycetes or to the Chytridiales or to the Proteomyxa and other Protozoa. The author gives a very fair discussion of the various claims that have been proposed by various authors.

The final chapter discusses the two diseases of cultivated plants that are of economic importance: Clubroot of cabbage and other Crucifers, caused by *Plasmodiophora brassicae*, and powdery scab of potatoes, caused by *Spongospora subterranea*. The known hosts are listed, the types of lesions and damage are described, the resistance and susceptibility of different host varieties and the geographical distribution are discussed rather fully. The methods of control are given considerable space. A rather complete bibliography completes this chapter.

The book is unfortunately marred by rather numerous typographical errors, a few of spelling but most of incorrect dates, page and figure references, etc. The appearance is that of extreme haste in the proofreading. In spite of this minor annoying feature the student of the Plasmodiophorales and related groups will find in this book a mine of information which will

save him a tremendous amount of searching the literature, which is, in many cases, rather inaccessible. He will have the main facts before him even on controversial points and will know where further research is necessary. He will perforce have to draw his own conclusions on many things, so fairly have the various sides of the subject been presented. This is perhaps the greatest compliment that a book of this type can receive.

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INORGANIC CHEMISTRY

A Textbook of Inorganic Chemistry. By FRITZ EPHRAIM. English edition by P. C. L. THORNE and E. R. ROBERTS. Fourth edition, revised and enlarged. 921 pp. New York: Interscience Publishers, Inc. $8.75. London: Gurney and Jackson. 28 shillings net. 1943.

THIS well-known text now appears in a fourth edition with only minor revisions and the addition of a dozen pages of new material. The recent work on radioactivity and isotopes has been included and descriptions of new compounds and reactions have been given. The progress in the field of artificial radioactivity is so swift that the discussion (p. 90) on nuclear fission, while it reflects opinion in 1940, does not correspond with the judgment of 1943 concerning the possibility of an era of atomic energy, which now appears not too far distant.

The outstanding advantage of this text is that it presents the field of inorganic chemistry in all its varied aspects from a consistent logical standpoint with a mode of presentation which departs refreshingly from the multitudes of inorganic chemical texts that have been written around a single traditional pattern. Ephraim's text is exactly suited to the senior student who wishes to refresh and refurnish his mind concerning basic inorganic chemistry in preparation for advanced examinations. It should be required reading for all professors of general chemistry, the exercise to be repeated as each new edition appears. The English editors deserve our best thanks for continuing to make this text accessible a decade after the original author's death and for their care in compilation and revision.

HUGH S. TAYLOR

REPORTS

THE AWARD OF GUGGENHEIM FELLOWSHIPS FOR 1944

THE sum of $200,000 has been appropriated this year by the John Simon Guggenheim Memorial Foundation for fellowships exclusively for men and women who are serving the nation in the war effort, in addition to sixty-nine fellowships with stipends of $155,000 to Americans and Canadians to assist their work of scholarship and artistic creation. All the fellowships are awarded, in wartime, subject to any national service to which the recipients may be called; but if any fellow is called into such service the foundation will make his fellowship available to him when he receives his discharge.

The appropriation of $200,000 for post-service fellowships is in addition to the usual budget. These funds will be used to grant fellowships to young scholars and artists who are serving the nation in the armed and other governmental services, including those doing war research under contracts made by the Office for Scientific Research and Development and similar agencies. They will be granted upon the same basis as the other fellowships, to persons who have demonstrated unusual capacity for research and artistic creation. They will be granted before the end of the war and will be made available to the recipients as soon as they are discharged from service. Five such fellowships have been awarded. They include one to Joseph Hickey, ornithologist, engaged upon war research at the University of Chicago. Mr. Hickey, who is the author of "A Guide to Bird Watching," proposes to make an analysis of approximately 250,000 records of banded birds to learn their life expectancies in the wild, their population turnover in nature and other facts of value to conservationists, and the mapping and charting of migration routes, especially for those species that are becoming endangered by civilization.

Awards of fellowships for the year 1944–45 include in the sciences:

DR. T. C. SCHNEIRLA, associate professor of psychology, New York University, and associate curator of animal behavior, the American Museum of Natural History, New York City: A study of the relationship between instinct and learning in insect psychology. The work will be based chiefly on his study of the behavior of army ants on the Isthmus of Tehuantepec, Mexico.

DR. R. A. STIRTON, lecturer and curator of fossil mammals, Museum of Paleontology, University of California at Berkeley: Exploration for fossil vertebrates in the Panamanian region of South America to obtain evidence concerning the date and position of water barriers between the American continents in prehistoric times.

Dr. Aaron J. Sharp, associate professor of botany, University of Tennessee: A study of the plants common to the Southern Appalachians and the temperate floras of the mountains and highlands of Mexico and Central America.

Dr. Bassett Maguire, curator in the New York Botanical Garden, Bronx Park, New York City: Exploration for unknown plants in the interior rain-forest and savannah lands of Dutch Guiana and along the lower Amazon River.

The origins of corn and tomatoes, food plants indigenous to the Western Hemisphere, will be studied by two fellows in Latin America:

Dr. Paul Weatherwax, professor of botany, Indiana University, will go to the highlands of Peru and Bolivia, one of the great pre-Columbian centers of agriculture, where corn may have been domesticated.

Dr. James Angus Jenkins, assistant professor of genetics, University of California at Berkeley, will work in the state of Jalisco, Mexico, on a genetic analysis of varietal differences in cultivated tomatoes.

Fellowships for work in the biological sciences are more numerous than those granted for work in any other field this year:

Dr. C. B. Van Niel, professor of marine biology, Stanford University, Hopkins Marine Station, Pacific Grove, Calif.: Studies of the new concepts of chemical and physical phenomena with a view to applications in general biochemistry.

Dr. Frank H. Johnson, assistant professor in biology, Princeton University: Studies of the fundamental mechanisms that control biological processes and phenomena.

Dr. Janet R. McCarter, assistant professor, department of agricultural bacteriology, University of Wisconsin: Studies in the field of immunology of infectious diseases, in particular observations on the aerological and biological activities of tuberculo-proteins.

Dr. Valy Menkin, associate in research, Fearing Research Laboratory, Free Hospital for Women, Brookline, Mass.: Studies of the chemical basis of inflammation in wounds.

Dr. Johannes F. K. Holtfreter, Rockefeller Foundation fellow at McGill University, Montreal: Investigations of the causal factors involved in the embryonic development of vertebrates. Dr. Holtfreter is one of the world's leading experimental geneticists. He is of German origin, and was sent from England to an internment camp in Canada, from which he was released upon the appeal of Canadian scholars who admire his work and have the highest esteem for him personally. For the past two years he has worked at McGill University as the guest of the university and under the auspices of the Rockefeller Foundation.

Dr. Emma Lucy Braun, associate professor of plant ecology, University of Cincinnati: Studies of the ecology and taxonomy of the deciduous forest.

Dr. George Neville Jones, associate botanist, University of Illinois, Urbana: A study of the botany of the Northwest Coast of America.

Dr. Tilly Edinger, research associate in paleontology, Museum of Comparative Zoology, Harvard University: A study of the development of teeth in the evolutionary line leading from ancestral fishes to mammals.

Dr. Kenneth W. Cooper, assistant professor of biology, Princeton University: Cytological studies of the pairing of sex chromosomes in the fruit fly.

Dr. William N. Takahashi, instructor of plant pathology, University of California at Berkeley (on leave, working at Cornell University: Plant virus investigations, from biochemical and physical points of view.

Dr. Hudson Hoagland, professor of general physiology, and director of Biological Laboratories, Clark University: A study of the physiology of psychotic patients.

In the field of mathematics Dr. André Weil, assistant professor of mathematics in Lehigh University, Bethlehem, Pa., will prepare a book on the foundation of algebraic geometry.

This is the nineteenth annual series of fellowship awards by the foundation, which was established and endowed by the late U. S. Senator Simon Guggenheim and by Mrs. Guggenheim as a memorial to their son John. The Guggenheim Fellowships are granted to creative workers in all fields who by their previous work have shown themselves to be persons of unusual ability, demonstrated by the previous production of contributions to knowledge or by the production of works of art. Men and women, married and unmarried, of all races and creeds who are citizens or permanent residents of the United States, citizens of Canada and of certain Latin American countries, are eligible on equal terms. The fellows are normally of ages between 25 and 40 years. The stipends are usually $2,500 a year. The fellowships now announced were granted to American and Canadian scholars and creative workers, while a series of fellowships for Latin Americans will be granted in June.

The fellows chosen this year come from twenty-one States and from three Canadian Provinces. Forty-three fellows are members of the staffs of thirty-seven educational institutions, two are in government employment and twenty-four are free-lance workers. Approximately nine hundred applications for the fellowships were presented this year.

The trustees of the foundation, in addition to Mrs. Guggenheim, are Francis H. Brownell, Carroll A. Wilson, Charles D. Hilles, Roger W. Straus, John C. Emison, Medley G. B. Whelpley and Charles Merz. The committee of selection consisted of Dr. Frank Aydelotte, director of the Institute for Advanced Study, *Chairman;* Dr. Florence R. Sabin, of the Rockefeller Institute for Medical Research; Professor Edwin Bidwell Wilson, of the Harvard University School of Public Health; Professor Linus Pauling, of the California Institute of Technology, and Professor Wallace Notestein, of Yale University.

SPECIAL ARTICLES

THE EFFECT OF ADRENAL CORTICAL AND PITUITARY ADRENOTROPIC HORMONES ON TRANSPLANTED LEUKEMIA IN RATS

It has recently been reported that removal of the adrenals greatly increases the susceptibility of rats to a transplanted lymphatic leukemia.[1] This result suggested that adrenal secretions have some inhibitory action on the development of the disease. The present report is based on preliminary tests of adrenal cortical extracts and of pituitary adrenotropic hormone which stimulates the secretion of the adrenal cortex. The experiments were as follows.

Rats from a highly susceptible strain were inoculated intraperitoneally with leukemic cells and some hours later intramuscular injections of a hormone preparation were started.

Desoxycorticosterone acetate.[2] This preparation in oil was given daily in .1 cc doses to 33 rats inoculated with leukemia and to 41 rats in the same dosage 3 times a week. Approximately 20 per cent. of these animals did not develop leukemia, while the rate of survival in the 70 control rats was 5.7 per cent.

Eschatin, a cortical extract[3] administered in .1 to .2 cc amounts twice a day gave from 20 to 37 per cent. protection against the development of leukemia with the controls showing no survivals.

Adrenal cortex hormones in oil (Upjohn[4]). Various doses of this preparation have been tested on 87 inoculated rats. In 3 groups given .05 cc doses (2 rat units) daily the survival rates were 44.4 per cent., 50 per cent. and 60 per cent., while the survival among the controls was less than 5 per cent. There was definite protection when .075 cc was given daily, but larger or smaller doses did not give so definite a result.

Pituitary adrenotropic hormone.[5] These results varied somewhat with different lots of the material. Among the 67 treated rats, one group showed as high as 75 per cent. survival. Over 40 per cent. of the whole treated group remained free of the disease, which is a definite effect when compared with the 10 per cent. survival among the 68 controls.

The above studies were made entirely with transplanted leukemia and the action of the hormone was to prevent the development of the disease. It would be entirely unjustifiable on the basis of these observations to predict that the adrenal hormone would be of value in treating either the transplanted or the spontaneous disease. The results have a certain scientific interest in presenting further evidence of hormonal control of the lymphoid system.

James B. Murphy
Ernest Sturm
The Rockefeller Institute for Medical Research, New York

[1] J. B. Murphy and E. Sturm, Science, 98: 568–569, 1943.
[2] Schering Corporation.
[3] Parke, Davis and Company.
[4] The Upjohn Company.
[5] We are indebted to Dr. H. O. Singher, of the Memorial Hospital, New York, for this preparation.

ADEQUACY OF THE ESSENTIAL AMINO ACIDS FOR GROWTH OF THE RAT

In a recent article, Albanese and Irby[1] have reported that rats lost weight rapidly on a diet which contained as the chief source of nitrogen the ten essential amino acids plus cystine. The relative amounts of amino acids were the same as in casein and were fed in quantity equal approximately to 14 per cent. of the total diet. When double the proportion of amino acids was fed, three out of six animals died and the remaining three ate poorly until they were sacrificed three weeks later. Despite the losses in weight, the animals on the 14 per cent. level amino acid diet maintained a positive nitrogen balance. These writers suggested that "the nutritive inadequacy of the essential amino acid diet may be due in part to toxic effects of unnatural forms of certain amino acids that cannot be utilized."

The above findings are not in agreement with results obtained by the present authors who, incidental to some other work, have regularly observed growth on diets containing the ten essential amino acids as the chief source of nitrogen. Also, Rose,[2] without giving the composition of the diets used or growth curves, states that animals fed a simplified diet containing the active amino acids (11.2 per cent.) "gained in weight just as rapidly as when all the protein components were supplied preformed." In view of the desirability of having the issue clarified, we have repeated and amplified our earlier experiments.

It will be noted that Albanese and Irby supplied the B vitamins in the form of yeast. Since the preformed protein components of yeast might alter the amount of growth, we have supplied all the necessary B vitamins in a pure form.

Young, inbred, Sherman strain albino rats were used in all the studies. The diets consisted of the same amino acid-free base[3] and a nitrogenous mixture which was varied in the following manner:

[1] A. H. Albanese and V. Irby, Science, 98: 286, 1943.
[2] W. C. Rose, *Physiol. Rev.,* 18: 109, 1938.
[3] Amino acid-free base.

Cod liver oil	2 grams
Corn oil	10 grams
Salt mixture	4 grams
Thiamin hydrochloride	224 micrograms
Riboflavin	400 micrograms
Pyridoxine hydrochloride	243 micrograms
Calcium pantothenate	1.5 milligrams
Nicotinic acid	2.5 milligrams
Choline chloride	134 milligrams
Para-aminobenzoic acid	1.0 milligram

Starch varied to make 100 grams of diet in conjunction with the nitrogenous components.

Diet	*Nitrogenous constituents*
1	10 essential amino acids at 5.8 per cent. level[4]
2	10 essential amino acids at 11.6 per cent. level
3	18 per cent. casein—paired feeding with diet 2
4	10 essential amino acids at 5.8 per cent. level plus 9 per cent. glycine in addition
5	18 per cent. casein—paired feeding with diet 4
6	18 per cent. casein—*ad libitum*

Results

The lower three curves of Fig. 1 (diet 1) show that rats will grow when the sole source of amino acid nitrogen consists of the ten essential amino acids at a level of 5.8 per cent.; however, as would be expected, they grow slowly. The middle curves (diet 2) show the results of feeding amino acids at double this level, *i.e.*, 11.6 per cent. It will be observed that the additional amount of amino acids considerably increases the growth rate. The nutritive value of this ration appears to be slightly over one half that of an 18 per cent. casein ration. This may be seen by comparing the curves representing animals on diets 2 and 3. The growth on the 11.6 per cent. amino acid mixture was nearly identical with that we have observed in other experiments when rats were fed *ad libitum* diets containing 9 per cent. casein.

The result of supplying additional nitrogen in the form of glycine, in addition to the ten essential amino acids at the 5.8 per cent. level, may be seen from the two lower curves of Fig. 2. The growth rates in these two animals does not appear to differ significantly from those in which the glycine was omitted. The absence of growth in this experiment may be accounted for only partly on the basis of food consumed. The latter may be seen from the growth of rats (diet 5) which were fed a diet containing 18 per cent. casein but in quantities identical with those consumed by the animals on diet 4.

The upper curves of Fig. 2 show the growth rates of rats fed *ad libitum* a diet in which the nitrogen was supplied in the form of casein at an 18 per cent. level. The latter experiment illustrates the adequacy of the base ration and shows that the amino acid content of the other rations represented the limiting factor for growth.

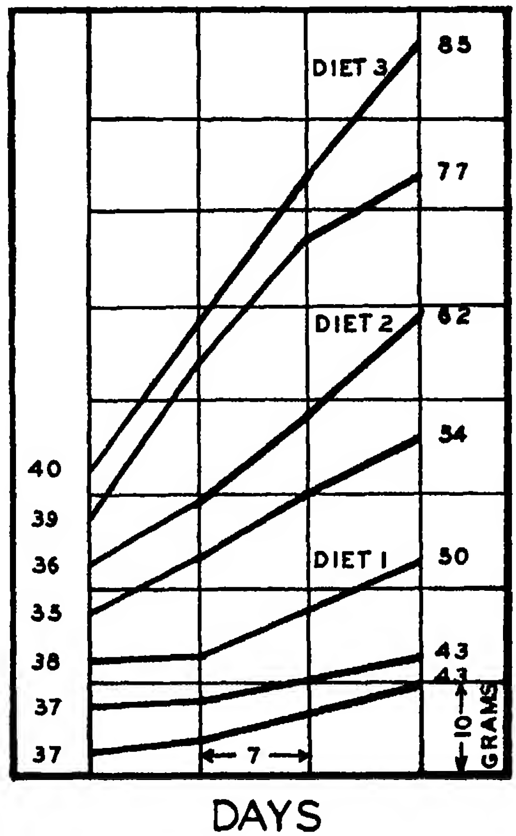

FIG. 1. Growth of rats on diets containing the following as the sole source of nitrogen: Diet 1, 10 essential amino acids at 5.8 per cent. level; Diet 2, 10 essential amino acids at 11.6 per cent. level; Diet 3, 18 per cent. casein—paired feeding with diet 2.

Discussion

The failure of glycine to augment the growth rate when added to the diet suggests that more than the mere addition of a source of nitrogen is required for good growth, even though the required amounts of the essential amino acids are provided. However, the possibility that glycine in these quantities is toxic has not been eliminated.

In the absence of additional data it is not possible

[4] Proportions of amino acids fed are those given by Rose as the minimal amount of each necessary to support normal growth when the non-essentials are included.

*Amino acid	Required level of the active form per cent.	Grams per 100 grams of diet as fed, corrected for HCl and inactive enantiomorph
l(-)arginine mono HCl	0.2	0.242
l(-)histidine mono HCl	0.4	0.494
dl isoleucine	0.5	1.000
l(-)leucine	0.9	0.900
l(-)lysine mono HCl	1.0	1.250
dl methionine	0.6	0.600
dl phenylalanine	0.7	0.700
dl threonine	0.6	1.200
dl tryptophane	0.2	0.200
dl valine	0.7	1.400

* All the amino acids used in these experiments were obtained from Merck and Company, Rahway, N. J.

to make a quantitative comparison with Rose's work. In general we have found that at the levels fed, the essential amino acids will give rise to almost as much growth as will an equivalent weight of casein.

We found no evidence of toxicity in spite of using racemic mixtures of six of the amino acids. Without knowing the source of the amino acids used by Albanese and Irby we cannot account for the widely different results obtained. Our findings for rats appear

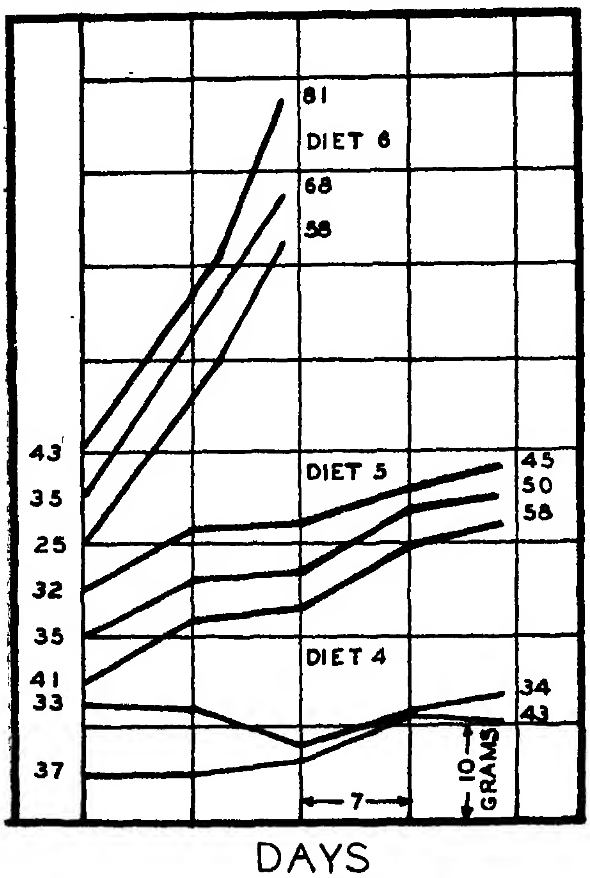

FIG. 2. Growth of rats on diets containing the following as the sole source of nitrogen: Diet 4, 10 essential amino acids at 5.8 per cent. level plus 9 per cent. glycine; Diet 5, 18 per cent. casein—paired feeding with diet 4; Diet 6, 18 per cent. casein—*ad libitum.*

compatible with those obtained in experiments on other animals. For example, Bauer and Berg[5] found slow growth when mice were fed the ten essential amino acids at a 15.6 per cent. level. Furthermore, Madden *et al.*,[6] using dogs, found that plasma protein production after feeding or injecting the essential amino acids was as good as when most proteins were fed in the diet. Moreover, they found no apparent clinical disturbance, even from the rapid injection of the amino acids intravenously.

SUMMARY

Growth was obtained in rats on synthetic diets in which the ten essential amino acids were the sole source of amino acid nitrogen. The growth rate was dependent upon the quantity of amino acids fed and appeared to compare favorably with that obtained when a similar quantity of nitrogen was fed in the form of casein. No increase in growth was observed when nitrogen in addition to that given in the form of the essential amino acids was supplied as glycine. Our experiments would not support the contention that the unnatural forms of the amino acids are toxic.

We wish to acknowledge and thank Phyllis Robison for technical assistance, and Dr. D. Mark Hegsted for helpful suggestions.

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METABOLIC EFFECTS OF THIOURACIL IN GRAVES' DISEASE[1, 2]

EARLY in 1943, Astwood[3] introduced a new type of therapy for Graves' disease. This was based on the goitrogenic effects of sulfonamides and certain derivatives of thiourea as demonstrated in animals by studies of the MacKenzies and McCollum[4, 5] and of Astwood and co-workers.[6] A systematic investigation of such compounds[7] showed thiouracil to be the most potent and least toxic and led to its selection for clinical trial by Astwood[3] and by Williams and Bissell[8] and others.[9] The mode of action of these drugs appears to be an interference with the enzymatic synthesis of thyroid hormone. The exact point of block is still not known, but it is definitely established that the thyroid gland is rendered incapable of utilizing iodine for this process. The resultant thyroid insufficiency leads, via anterior pituitary stimulation, to an ineffectual hyperplasia of the thyroid acinar cells. The peripheral action of administered thyroid hormone, however, remains unimpaired.

[5] C. D. Bauer and C. P. Berg, *Jour. Nutr.*, 26: 51, 1943.
[6] S. C. Madden, J. R. Carter, A. A. Kattus, Jr., L. L. Miller and G. H. Whipple, *Jour. Exp. Med.*, 77: 277, 1943.

[1] From the Russell Sage Institute of Pathology in affiliation with the New York Hospital and the Department of Medicine, Cornell University Medical College.
[2] With the technical assistance of Vincent A. Toscani.
[3] Astwood, *Jour. Am. Med. Asn.*, 122: 78, 1943.
[4] MacKenzie, MacKenzie and McCollum, SCIENCE, 94: 518, 1941.
[5] MacKenzie and MacKenzie, *Endocrinol.*, 32: 185, 1943.
[6] Astwood, Sullivan, Bissell and Tyslowitz, *ibid.*, 32: 210, 1943.
[7] Astwood, *Jour. Pharmacol. and Exp. Therap.*, 78: 79, 1943.
[8] Williams and Bissell, SCIENCE, 98: 156, 1943; *New Eng. Jour. Med.*, 229: 3, July, 1943.
[9] Himsworth, *Lancet*, 245: 483, 1943.

Clinical reports to date[1-6] on the use of thiouracil (and to a lesser extent, thiourea[7]) in Graves' disease have shown that this drug has a similar action in man; there is a decrease in the basal metabolic rate and in the protein-bound iodine of plasma, an increase in serum cholesterol and body weight and a disappearance of the symptoms of Graves' disease. No improvement in exophthalmos has been noted; and the effect on the size of the gland has been variable. Toxic reactions have been few, the most notable being a nonfatal agranulocytosis.

It would reinforce the value of thiouracil for the treatment of Graves' disease were the beneficial effects noted above also accompanied by the correction of other metabolic derangements characteristic of this condition, such as is achieved by successful thyroidectomy or iodine remission. With this in mind, a series of patients with Graves' disease are being subjected to detailed metabolic study in the metabolism ward of the Department of Medicine at the New York Hospital. They are placed on constant creatin-creatinine free diets and observations made of the influence of thiouracil on the disturbances in creatin, creatinine, calcium, phosphorus and nitrogen metabolism, as well as on several other indices of thyroid activity. In this preliminary report, the data on one such case are presented in detail in graphic form.

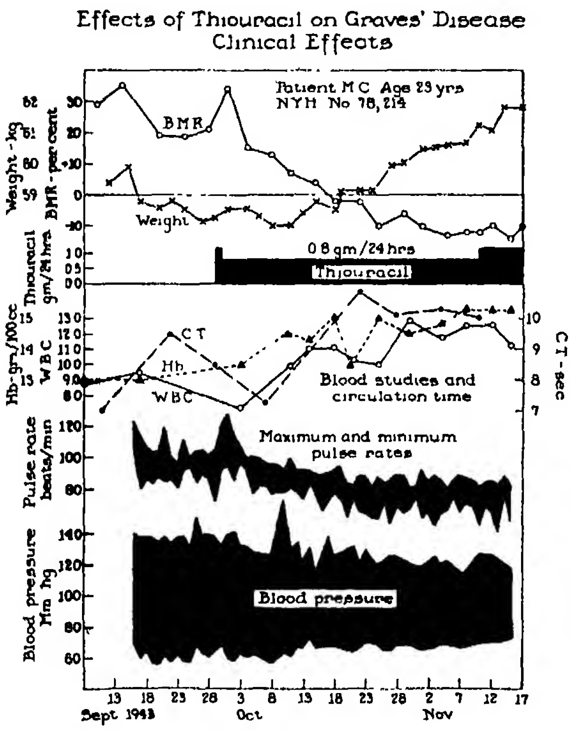

FIG. 1

The patient was a 23-year-old white girl with typical signs and symptoms of Graves' disease of moderate severity and of two years' duration, uncomplicated except for moderate exophthalmos. The gland was moderately enlarged. Balance studies were carried on for two weeks prior to, and for fifty days during the administration of thiouracil. The constant creatin-creatinine free diet provided 2,400 calories, 76 gm protein, 107 gm fat, 283 gm carbohydrate, 1.19 gm calcium and 1.41 gm phosphorus. There was a temporary symptomatic improvement on bed rest alone during the control period, followed by an acute exacerbation of symptoms which was progressive until the fourth day of treatment with thiouracil. From

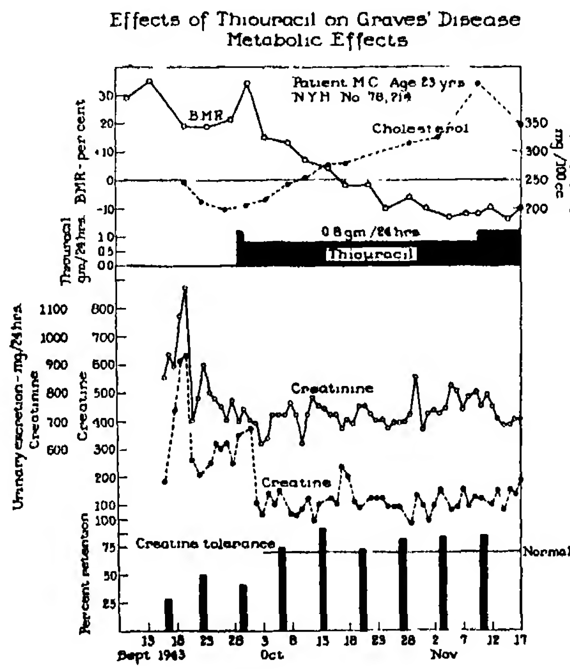

FIG. 2

that time on, improvement was rapid and striking in almost all respects. The symptomatic relief was accompanied by an improvement in all the metabolic functions studied, the details of which are given in Figs. 1, 2 and 3.

The creatinuria was sharply reduced from control levels; however, it still persisted at somewhat higher than the average normal levels. The creatin tolerance following the administration of 1.32 gm of creatin rose rapidly to, and remained within, the normal range. An increase in creatinine excretion was not observed but was not anticipated over this short period. Sugar tolerance tests were normal before treatment and remained so. Nitrogen, phosphorus and calcium balances became progressively more positive. The im-

provement in calcium balance occurred chiefly from a reduction in calcium excretion in the stool. In another patient of this series, however, the chief re-

Effects of Thiouracil on Graves' Disease
Metabolic Effects

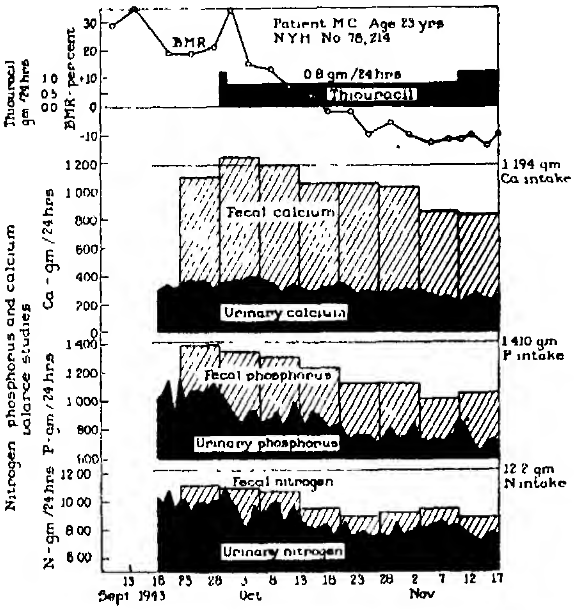

FIG. 3

duction in calcium excretion after thiouracil took place in the urine, calcium content of which fell from the control level, 575 mgs, to the neighborhood of 214 mgs per 24 hours. No changes were noted in the size of the gland or degree of exophthalmos. The purpose of the increased dosage of thiouracil during the last week was to ascertain the degree of thyroid insufficiency which could be achieved; although the basal metabolic rate still remained at – 10 per cent. to – 15 per cent., serum cholesterol rose to myxedematous levels of 350–415 mgs per cent. during this period.

No toxic manifestations were encountered in this patient. In another patient of the series, mild jaundice with an icteric index of 23 developed after 20 days of thiouracil (0.8 gm daily). There was no demonstrable evidence of hemolysis or hepatic damage at the time. Subsequent gall bladder x-rays and liver function tests were entirely normal. There was a return of the icteric index to normal within 10 days of stopping the drug. Two other patients of a series of 12 treated with thiouracil developed urticarial eruptions which disappeared on discontinuing the drug and reappeared in one of the two patients when treatment was reinstituted a week later. The possibility of toxic hepatitis appears to warrant routine icteric indices during at least the initial stages of treatment.

In conclusion, the effects of thiouracil on the disturbances of calcium, phosphorus, nitrogen and creatin metabolism occurring in Graves' disease are comparable to the beneficial results following successful subtotal thyroidectomy or iodine remission. These findings indicate the physiological nature of the remission produced by this new chemotherapeutic agent.

MARGARET H. SLOAN
EPHRAIM SHORR

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A DIFFERENTIAL TRIPLE STAIN FOR DEMONSTRATING AND STUDYING NON-ACID-FAST FORMS OF THE TUBERCLE BACILLUS IN SPUTUM, TISSUE AND BODY FLUIDS[1]

IN 1932, non-acid-fast forms of the tubercle bacillus[2] were studied by means of several improved counterstain technics. One was devised which gave the most striking results of all for differentiating the acid-fast and non-acid-fast rods and granules.[3] It consisted in staining first by the usual Ziehl-Neelsen method, decolorizing with acid alcohol and then adding to each slide, flooded wth Loeffler's methylene blue counterstain, 6 to 8 drops of an experimentally determined optimum strength of NaOH (0.05 per cent. for avian strains and 4 per cent. (normal strength) for human strains). Whereas this counterstain method was excellent for pure cultures of tubercle bacilli, it was unsuitable for use with sputum, tissues or body fluids, since the background took on and held an intensely blue color which obscured the contrast; thus any other species of bacteria present would also appear blue.

An attempt was made, therefore, to find some means of bleaching out the methylene blue from the background without removing the blue color from the non-acid-fast forms of the tubercle bacilli. Tests were made on pure cultures of tubercle bacilli and of tubercle bacilli mixed with a number of other organisms, including staphylococci, streptococci and *C. diphtheriae*. Controls were made by staining pure cultures of these non-acid-fast species alone. An excellent bleaching agent was found. It is sodium hydrosulfite, a substance used as a discharge or "stripping" agent in the textile industry. This substance in

[1] This work was supported by a grant from the Rosenwald Family Association, and was carried on mainly in the laboratories of Dr. Morton C. Kahn, Department of Public Health and Preventive Medicine, Cornell University Medical College.

[2] M. C. Kahn, *Am. Rev. Tuber.*, 20: 2, 150, 1929; E. G. Alexander, *Proc. Soc. Exp. Biol. and Med.*, 21: 1104, 1934; M. B. Lurie, *Jour. Exp. Med.*, 69: 576, 1939.

[3] E. G. Alexander, SCIENCE, 75: 197, 1932.

a strength of approximately 0.25 per cent. (or a small pinch in about 50 ml of tap water *freshly* prepared *just* before using, selectively bleached the blue color from the background and from all the organisms tested excepting the tubercle bacilli, without affecting the red color of the carbol-fuchsin stained rods or the blue color of the methylene-blue stained non-acid-fast forms of *M. tuberculosis*.

Subsequently, known pure cultures of tubercle bacilli were mixed with non-tuberculous sputums and were stained by the new technic. The results were striking. Acid-fast organisms were red, non-acid-fast forms were blue, partially acid-fast forms mulberry color, while other organisms, tissue cells and mucus formed an effective light green background with the third stain used; this consists of equal volumes of aqueous solutions of 1 per cent. acid green[4] and 1 per cent. acid yellow.[4] Every slide stained by the triple staining method was controlled by a duplicate smear stained by the ordinary Ziehl-Neelsen technic. Thereafter, hundreds of slides of tuberculosis sputum, tissue and body fluids—particularly chest fluids[5]—were stained by the triple stain technic with Ziehl-Neelsen controls, with satisfactory results.

This triple method of staining should be a useful supplement to the usual Ziehl-Neelsen technic since it reveals a number of interesting non-acid-fast forms which ordinarily escape observation.[6] One of these forms is zoogleal, consisting of one or more granules embedded or enmeshed in amorphous material and is not stained by the usual Loeffler's methylene blue or dilute methylene blue counterstains. This form, stained and unstained, has been the subject of intensive study and is being described in detail elsewhere. Ubiquitous saprophytic diphtheroids obtained from a variety of non-tuberculous materials such as normal guinea-pig serum or heart's blood, tap water, or hay, apparently are also able to enter a zoogleal state similar to this newly demonstrated zoogleal state of *M. tuberculosis*, and are distinguished from *M. tuberculosis* by the relative ease and speed with which such forms develop into rods on culture, the non-acid-fast character of all their rod forms, and, of course, by their complete lack of pathogenicity for the guinea pig.

TECHNIC OF THE TRIPLE STAIN FOR TUBERCLE BACILLI

(1) Prepare smears which are not too thick, fix carefully with heat, and stain as usual three minutes with carbol-fuchsin.[7] Decolorize for one to three minutes with acid alcohol (3 per cent. HCl) and wash thoroughly in running tap water.

(2) Flood the slides with a well-ripened Loeffler's methylene blue. Then add with a dropper 6 to 8 drops of normal NaOH with a capillary pipette. Distribute the alkali by tipping the slides gently; let stand for not more than one minute; wash. The NaOH must be freshly prepared about once a month for good results.

(3) Flood the slides one at a time, with sodium hydrosulfite solution (freshly prepared just before using by adding a small "pinch" of hydrosulfite to about 50 ml of tap water in a beaker or flask). Decolorization of the deep blue smear will speedily take place (except for red acid-fast and the non-acid-fast tubercle bacilli, which on microscopic examination appear blue). Wash off quickly in running tap water and immediately flood the slide with the green stain (an aqueous solution of equal volumes of 1 per cent. acid green and 1 per cent. acid yellow). Wash off the green in a few seconds, and blot dry at once. When stained preparations are thick, parts will appear blue rather than green, thus preventing clear differentiation in those areas. On the other hand, if the sodium hydrosulfite solution is too strong, the background and species of bacteria other than the tubercle bacillus will appear grayish.

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[4] National Acid Green L Extra, C.I. No. 666 and National Quinoline Yellow C.I. No. 801 were found suitable.

[5] Most of the material was obtained from the laboratory of Tuberculosis Service at Bellevue Hospital through the kindness of Dr. J. Burns Amberson, director, and Miss Edna Stein, bacteriologist.

[6] E. Alexander-Jackson, *Am. Rev. Tuber.*, 33: 6, 789, 1936.

[7] To protect smears against precipitated particles of carbol-fuchsin stain, it is advisable to lay a strip of clean filter paper across each fixed smear prior to adding the dye.

BOOKS RECEIVED

BARTON, WM. H., JR. *World Wide Planisphere for Finding and Identifying Navigation Stars and Constellations from all Latitudes, North or South throughout the Year.* Addison-Wesley Press, Inc. $2.50.

BARTON, WM. H., JR., and CHARLES O. ROTH, JR. *Basic Problems in Celestial Navigation.* Illustrated. Pp. 56. Addison-Wesley Press, Inc. $1.00.

CHAPIN, WILLIAM H. *Exercises in Second Year Chemistry.* Fourth edition. Revised by WERNER E. BROMUND and L. E. STEINER. Illustrated. Pp. vii + 216. John Wiley and Sons, Inc.

Contributions to American Anthropology and History. Illustrated. Pp. 260. Publication No. 546 of the Carnegie Institution of Washington. $3.50, paper cover; $4.00, cloth binding.

HAUSMANN, ERICH and EDGAR P. SLACK. *Physics.* U. S. Naval Academy edition. Illustrated. Pp. vii + 857. D. Van Nostrand Company, Inc. $5.50.

Selected Papers of William Frederick Durand. Reprinted in Commemoration of the Eighty-fifth Anniversary of His Birth. Pp. 123. California Institute of Technology.

The Technique of Motion Picture Production. A Symposium of Papers presented at the 51st Semi-Annual Convention of the Society of Motion Picture Engineers, Hollywood, California. Illustrated. Pp. viii + 150. Interscience Publishers, Inc. $3.50.

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PRODUCTION OF OIL FROM PLANT MATERIAL

By Professor E. BERL
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INTERESTING information is given about the oil situation in this country in the excellent article by Dr. P. K. Frolich,[1] past president of the American Chemical Society. Dr. Frolich states that the time is not far off when oil products should be obtained from sources other than natural oil, for example, by the hydrogenation of coal or carbon monoxide produced from coal or from natural gas or from oil shales. Not all experts in this field agree with statements about the coming scarcity of oil within the boundaries of the United States.[2]

In previous communications to SCIENCE,[3] I have stated that carbohydrates which are contained in farm products, wood, algae, etc., and which are formed by nature in enormous amounts and with greatest ease (see Table 1) can be converted into liquid fuel.[4]

According to such statistics, at the present rate of oil extraction, the cheap oil in this country would be gone in about fourteen years; therefore, it is imperative

TABLE 1

Plants	2.7×10^{11}	metric tons of C content
Annual production of cellulose and other carbohydrates	3×10^{9}	" " " "
Crude oil reserves in U. S. A.	2.64×10^{9}	" " " "
Crude oil reserves in world	4.4×10^{9}	" " " "
Annual oil production U. S. A.	1.93×10^{8}	" " " "
Annual world oil production	2.94×10^{8}	" " " "

that ways and means should be used in order to allow a continuous production of liquid fuel after the exhaustion of that oil under ground which can be recovered at relatively small cost.

One can get from cornstalks, corn cobs, sugar-cane, bagasse, seaweed, algae, sawdust, Irish moss, molasses, sorghum, grass or any other carbohydrate-containing

[1] P. K. Frolich, SCIENCE, 98: 457, 484, 1943.
[2] W. Pratt, *Oil and Gas Jour.*, January 30, 1944, p. 78.
[3] E. Berl, SCIENCE, September, 1934, and January, 1935.
[4] J. G. Lippmann, *Ind. Eng. Chem.*, 27: 105, 1935.

material by a controlled internal combustion a material called "protoproduct." This protoproduct contains about 30 per cent. of phenol carbonic acids, 4.5 per cent. phenols and 63.5 per cent. neutral material. It is semi-liquid at room temperature and liquid at somewhat higher temperatures. It contains about 60 per cent. of the carbon content of the original plant material. This "carbon" yield is practically identical with the yield which one gets when water-soluble carbohydrates are converted into alcohol by fermentation. The yield in K cal (BTU)—thermal efficiency—for the conversion of plant material into liquid fuel is rather high. One long ton of dry sugar-cane (4.33×10^6 K cal "upper" heating value and 3.97×10^6 "lower" heating value)[5] contains .5 tons C. With a 60 per cent. carbon conversion, .375 tons of protoproduct (with 80 per cent. C) result which produce 3.28×10^6 K cal "upper" or 3.09×10^6 K cal "lower" heating value. The thermal efficiency is therefore 75.6 and 77.7 per cent., respectively.[6] A thermal efficiency of 76 per cent. based on oxygen-free material results if the protoproduct is hydrogenated and the asphaltic material discarded. The aforementioned "protoproduct" as a hydrophobic substance separates easily from the watery medium. No further concentration is necessary. Fermentation alcohol results as a diluted (5–8 per cent.) material which afterwards has to be concentrated to get industrial alcohol.

TABLE 2

Material	Sp. wt.	K cal/kg.		BTU/lb.		K cal/liter		BTU/gal.	
		upper	lower	upper	lower	upper	lower	upper	lower
Protoproduct	1 14	8,736	8,250	15,725	14,850	9,960	9,405	119,580	141,263
100 per cent. ethanol.	.794	7,092	6,370	12,765	11,465	5,630	5,058	84,578	75,970
95 per cent ethanol.	.809	6,737	5,984	12,127	10,771	5,450	4,841	81,860	72,712
Gasoline	70	11,000	10,000	19,800	18,000	7,700	7,000	115,655	105,140

Upper heating values: Liquid water in the combustion gas.
Lower heating values: Water vapor in the combustion gas.

The protoproduct can be used as fuel oil or, with or without a simple treatment, in Diesel engines. Table 2 shows the superiority of the protoproduct (sp. wt. 1.14) over alcohol in its BTU (K cal) content per weight or volume unit.

About 50 per cent. of oxygen are contained in plant material, for example, in dry, ash-free sugar-cane. Protoproduct made from sugar-cane contains 20–10 per cent. of bound oxygen which can be removed by hydrogenation or by cracking. Hydrogenation of the liquid protoproduct can be carried out much more simply than that of pulverized older lignites or younger bituminous coals. After hydrogenation about 45 per cent. of the original carbon content of, for instance, sugar-cane results as gasoline, kerosene and lubrication oil. Gasoline (boiling up to 200° C. or 392° F) contains 20 per cent. of aromatics. 17.4 per cent. of the original carbon content in sugar-cane are found in this gasoline. The kerosene fraction contains 19.7 per cent. of the sugar-cane carbon. It can be cracked to lower boiling hydrocarbons. The lubrication fraction with 7.6 per cent. of the carbon content in sugar-cane shows properties identical with that of lubrication oil obtained from natural oil. The remaining asphalt-like material with 15 per cent. of the sugar-cane carbon retains after hydrogenation a few per cent. of bound oxygen. It derives mostly from the lignin content of the plant. The asphaltic material can be used for purposes where natural asphalts are used, or it can be burned as is done with pitch.

Table 3 shows conversion results for sugar-cane of which in continental U. S. (Louisiana) 18.55 long tons and in Hawaii 33.2 long tons are produced per acre a year.[7]

Our generation is rather careless with those savings which nature put under ground many millions of years ago. We recover oil from underground often with low yields.[8] We use up this oil rather imperfectly in a very short time. Then it is gone forever. It would be wise and practical to use more and more agricultural

TABLE 3

a. From 100 long tons dry sugar-cane result
2,980 gal. gasoline
3,430 " middle oil
1,210 " lubrication oil, or
8.45 long tons raw cane sugar (Louisiana)
10.0 " " " " " (Hawaii)

b. From 100 long tons dry bagasse (resulting from 110 tons dry sugar-cane)
2,550 gal. gasoline
2,950 " middle oil
1,020 " lubrication oil

[5] The "upper" heating value is related to liquid water, the "lower" heating value to water vapor in the combustion products.

[6] The remaining 24.4 per cent. thermal efficiency are found in the compounds contained in the watery liquid and in the gas. This high thermal efficiency of 75.6 (77.7) per cent., which does not include the relatively small amount of heat necessary for the conversion, may be compared with the 30 per cent. thermal efficiency in the coal hydrogenation plant in Billingham (see later).

[7] U. S. Department of Commerce, Statistical Abstract of United States, 1941.

[8] Improved yields can be obtained with the use of the writer's U. S. Patent No. 2,267,548.

products for the production of liquid and semi-liquid fuel, and if necessary, of solid fuels. Nature produces per annum 3×10^9 tons carbon content in carbohydrate-containing material. The world consumption of oil at present is estimated to be 2.94×10^8 tons carbon content per year. The annually produced cellulosic plant material[4] (see also Table 1) would allow the production of about six times the actual oil consumption with an overall carbon conversion of 60 per cent. and a thermal efficiency of 75.6 and 77.7 per cent., respectively.

Thirty million (3×10^7) cars on the U. S. highways in 1941, the last "normal" year in this country, consumed 5.56×10^7 long tons of liquid fuel. If this amount of liquid fuel were to be produced from sugar-cane, due to the lower yield per acre a year in the continental United States, 9.7×10^6 acres would be needed, and with a sugar-cane production per acre a year as in Hawaii, Puerto Rico, Philippine Islands and Cuba, 5,420,000 acres would have to be planted with sugar-cane. These figures are based on the conversion to protoproduct only. If this protoproduct were converted into oxygen-free gasoline, then for continental U. S. 1.32×10^7 and in countries with a climate similar to that of Hawaii, 7.37×10^6 acres would be needed. In the last figures, the amount of raw material necessary for the deoxidation of the protoproduct is not included. The cropland harvested in the U. S. amounts to 3.2×10^8 acres. The 9.7×10^6 and 1.32×10^7 acres in continental U. S. would correspond to 3.4 per cent. and 4.13 per cent. respectively of harvested land and 1.7 per cent. and 2.3 per cent., respectively, of the land available for crops (5.3×10^8 acres).

6.6×10^7 tons of liquid fuel—in other words, more than the 30,000,000 cars consumed in 1941—could be produced in the U. S. A. if the 2.6×10^8 tons of plant waste produced annually would be converted into liquid fuel.

In this country and more advantageously in countries with tropical climate, very large amounts of carbohydrate-containing material can be produced. Table 4 shows the yields per acre a year for sugar-cane crops (which allows the maximum carbohydrate production per acre a year) in the continental United States and in Hawaii.[7] From dry sugar-cane, bagasse (Table 3) or other crops, interesting amounts of protoproduct and oxygen-free liquid fuel can be obtained. In using these, one would not use up the present oil reserves with dangerous speed. One would not consume coal of which about five tons are necessary to produce one ton of liquid fuel (this corresponds to 30 per cent. thermal efficiency) and one would not run into difficult transportation problems which are connected with the use of oil shale and disposal of distilled material. Oil shale allows the production of 30–70 gallons of oil with .90–.77 tons of valueless residue per ton of shale.

TABLE 4

ANNUAL PRODUCTION FIGURES FOR CONTINENTAL U. S. AND FOR HAWAII FOR 1937–1940[7] AND CONVERSION FIGURES INTO OIL

	Total acreage harvested for sugar cane and seed	Total product. of sugar-cane and seed long ton	Long ton sugar-cane/acre	Raw sugar long ton	Raw sugar long ton/acre	Long ton raw sugar/long ton cane	Long ton proto-product per acre	Barrels proto-product per acre	Long ton proto-product by total conversion of sugar-cane	Barrels proto-product by total conversion of sugar-cane
Continental U. S.	2.92×10^5	5.01×10^6	18.55	4.24×10^5	1.45	.085	5.565	30.7	1.625×10^6	8.96×10^7
Hawaii	2.36×10^5	7.83×10^6	33.20	7.83×10^5	3.32	.10	9.96	55.0	2.35×10^6	12.98×10^7

The total production of sugar-cane in Hawaii, Puerto Rico, Philippine Islands and Cuba which have practically the same climate and, therefore, the same production of sugar-cane in long tons per acre a year can be seen from Table 5.

TABLE 5

Hawaii	7.83×10^6
Puerto Rico	7.83×10^6
Philippine Isl	9.4×10^6
Cuba	35.2×10^6
	60.26×10^6

From these four countries one could produce 1.8×10^7 tons of liquid fuel, which is nearly one third of the consumption in 1941 for the 30,000,000 cars. The planting of sugar-cane in these and other tropical countries, for instance, Brazil, certainly could be multiplied provided there would be a use for the increased sugar-cane output.

9.7×10^7 acres planted with sugar-cane would be needed in the continental United States to produce the alcohol equivalent to 5.56×10^7 long tons of liquid hydrocarbon fuel. This compares with the above-mentioned 9.7×10^6 acres planted in continental U. S. necessary to furnish the fuel for 3×10^7 cars. Less than 10 per cent. of the sugar-cane content present as saccharose are converted into alcohol. With the process of the writer, altogether 70 per cent., which represents the total carbohydrate content of the sugar-cane, including cellulose, can be converted into liquid fuel.

The synthetic fuel production in Fortress Europe dominated by Germany is estimated to be 1×10^7 tons,

to which $4\text{–}5 \times 10^6$ tons of natural crude produced in Roumania, occupied Poland, Austria and Germany have to be added. In other words, the 1.8×10^7 tons of liquid fuel which could be produced from the present sugar-cane production in Hawaii, Puerto Rico, Philippine Islands and Cuba are 80 per cent. higher than Germany produces in her synthetic oil plants, in which certainly more than $2,000,000,000 have been invested. Continental U.S.A. produces now 2.2×10^8 tons of crude oil.

That hydrogenation of coal with the Bergius-I. G. process and of carbon monoxide with the Fischer-Tropsch process is carried out on a large scale in Germany (10,000,000 tons per year) is not perfect proof that these processes under the present conditions is the only way to end the oil shortage for this and other countries. Great Britain has not enlarged her Billingham coal hydrogenation plant, with about 150,000 tons of oil products per year.[9] Hydrogenation of coal and carbon monoxide can not be carried out without large government subsidies (6.65 cents per gallon on home-produced petrol in Great Britain).

Any synthetic method whatsoever must produce liquid and solid fuels at prices higher than the very low present prices of natural oil and bituminous coals in this country. Farish[10] and Williams[11] gave data from which the high price of coal hydrogenation products can be seen (22.6 cents per gallon for gasoline with coal hydrogenation,[10] 24.4 cents per gallon with carbon monoxide hydrogenation from coke,[11] 19.2 cents from bituminous coal,[10] 18.2 cents from subbituminus coal,[11] 18.2 cents[11] and 8.8 cents[10] respectively from natural gas). Direct costs per gallon of gasoline are 15.9 cents for coal hydrogenation[10] and 14.7 cents for carbon monoxide hydrogenation.[10] 6.7 and 4.5 cents per gallon, respectively, have to be spent for 10 per cent. depreciation. The production of liquid and semi-liquid fuels from plant material, especially in tropical and subtropical countries, or where practically valueless wastes result, can be made at rather low prices provided the transportation problem does not offer special difficulties.

This plant conversion process has the great advantage that it does not touch the materials underground. In this and other countries the farmer must produce more raw materials for industrial purposes. In smaller installations, plant material could be converted into the fuel which is necessary for his tractors and for heating his home. This can not be done by the coal hydrogenation which, according to our present knowledge, must be carried out in large and very costly installations.

The plant conversion process puts liquid fuel at the disposition of practically all civilized nations. Any country which is not blessed with natural oil and which has or can develop an adequate agricultural or forest production can now produce an important part of its liquid fuel needs.

The author expresses his thanks to A. Schmidt, H. Biebesheimer, W. Dienst, A. B. Cramer, H. Heinemann and D. Myers for their valuable collaboration.

OBITUARY

MEMORIAL TO FRANK LEVERETT

ON November 15, 1943, after an illness of only a few weeks, Frank Leverett passed away at his home, 1724 South University Avenue in Ann Arbor, Michigan, at the age of 84 years. Until the time of his last illness he was active in researches dealing with glacial geology, a field in which he had gained a most enviable and world-wide reputation.

Frank Leverett was born at Denmark, Iowa, on March 10, 1859, the son of Ebenezer Turner Leverett and Rowena (Houston) Leverett. He was descended from a line of ancestors that emigrated from Boston, England, to Boston, Massachusetts, in 1663.

Upon completion of his academic training in Denmark Academy, Leverett taught in the public schools during 1878–1879. For three years following, until 1883, he served as instructor in natural sciences at Denmark Academy. It was in this position, while conducting field excursions with his classes, that he first became interested in the study of geology. In the fall of 1883 he entered Colorado College, where he took courses in mineralogy and assaying. In 1884 he enrolled in Iowa State College of Agriculture and Mechanic Arts and was graduated from that institution with a degree of bachelor of science in 1885.

Following his graduation from Iowa State College, Leverett journeyed on foot to Madison, Wisconsin, to confer with T. C. Chamberlain, then president of the university, concerning the possibility of obtaining a job on the U. S. Geological Survey. Being director of the Division of Glacial Geology in the Federal Survey, Chamberlin made an opening for young Leverett and assigned him to a temporary job as field assistant in glacial geology. Inspired by this opportunity to engage in a field of work which seemed to satisfy completely his cravings for scientific adventure, Leverett

[9] W. A. Bone and G. W. Himus, Coal, Its Constitution and Uses, 1936, p. 556.

[10] W. S. Farish, Committee on Mines and Mining, House of Representatives, July 15, 1942.

[11] J. P. Williams, Subcommittee on War Minerals of the Committee on Public Lands and Surveys, U. S. Senate, August 6, 1943 (Pittsburgh).

gave such a good account of himself that he was continued as an assistant until 1890, when he was appointed to the position of assistant geologist on the Survey. In 1901 he was advanced to geologist and in 1928 to senior geologist, a position which he held until his retirement in 1929.

During his forty-three years of continuous service with the U. S. Geological Survey, Leverett's achievements in the field of glacial studies gained for him world-wide recognition as one of the leading authorities on Pleistocene glaciation. He was an indefatigable investigator and never ceased to take a wholehearted and genuine interest in the problems connected with that field of science.

Leverett spent the year 1908 in Europe, where he became personally acquainted with many of the leading glacialists on the continent. His numerous excursions into the glaciated tracts abroad gave him an opportunity to draw comparisons between the glacial deposits of Europe and those of North America which, through a long period of years, he had covered so thoroughly on foot or by means of horse and buggy.

Frank Leverett was twice married. His first wife was Frances E. Gibson, whom he married in 1887. In 1895, several years after her death, he was married to Dorothy C., daughter of Russell and Dorothea (Schmidt) Park, who survives him. There were no children by either marriage.

For a period of twenty years, from 1909 to 1929, Leverett served as a special lecturer in glacial geology on the staff of the University of Michigan. He was a skilful and resourceful teacher, greatly beloved by his students. He drew freely upon his great wealth of knowledge gained from personal experience and was able to make the subject of glaciation a most attractive study. He took great interest in his students, old and young alike, and never grew tired explaining over and over again perplexing problems that to him were nothing more than simple principles, so well did he know them. Following his retirement from active service with the U. S. Geological Survey, the University of Michigan conferred upon him the honorary degree of doctor of science in 1930.

Leverett was elected a fellow of the Geological Society of America in 1891, the year after its founding. In 1910 he served as the second president of the Michigan Academy of Science, Arts and Letters and subsequently contributed many valuable papers during his long membership in that organization. He was honored with election to membership in the American Philosophical Society in 1924. He was a fellow of the American Association for the Advancement of Science and served as its vice-president during 1928. In 1939 he was elected to membership in the National Academy of Sciences. He was a member also of the Science Academies of Iowa, Wisconsin and Washington (D. C.), the Forestry Association, the Geophysical Union, and served as a corresponding member of the National Geographic Society. He held memberships in the honorary fraternities of Phi Kappa Phi and Sigma Xi.

Frank Leverett was a prolific writer. His bibliography lists some 170 titles in the form of reports, water supply papers, bulletins, monographs, professional papers and miscellaneous papers published in the period between 1889 and 1943. The greater part of these pertain to problems in Pleistocene geology and water resources. Outstanding as a classic is his Monograph 53 (with Frank B. Taylor), "The Pleistocene of Indiana and Michigan and the History of the Great Lakes," published by the U. S. Geological Survey in 1916.

Leverett spent a lifetime doing a big job well. His critical interpretations of natural phenomena and his masterful portrayal in writing of his observations marked him as a truly great scientist. He learned his facts first hand and spared no effort in making certain that he understood the meaning of the features he observed before he translated them into his published writings. He considered his work in the field of glacial geology as merely an open door to a vast multitude of problems that should engage the efforts of glacialists for generations to come.

Leverett's private study in his home in Ann Arbor was an open classroom to an almost endless procession of geologists who sought his expert advice and counsel. He seemed to have a peculiar personal concern for the younger geologists and would spend hours assisting them with their problems. He took special delight in recounting the highlights of his personal travels and experiences.

A great scientist, a masterful teacher, but in all a modest man of remarkable wisdom, Frank Leverett will be remembered by all who knew him for his great love of glacial geology. His works will stand as an enduring monument to a lifetime of purposeful achievement.

Stanard G. Bergquist

Michigan State College

DEATHS AND MEMORIALS

Jesse Pawling, from 1925 to 1935 associate astronomer at the U. S. Naval Observatory in Washington, D. C., died on April 11 at the age of seventy-eight years. Mr. Pawling graduated from Cornell University in 1893 and after several years of graduate work in other universities and teaching physics in Philadelphia, he went to the Naval Observatory in 1905, where for thirty years he worked on positional astronomy.

William Titus Horne, professor of plant pathol-

ogy at the University of California, plant pathologist at the Citrus Experiment Station at Riverside, died on April 12 at the age of sixty-seven years.

Dr. John L. Rose, for the past fifteen years an instructor in physics at New York University and supervisor of the laboratory of physics, who recently joined the War Research Division of Columbia University, died on April 13 at the age of forty-seven years.

Dr. Arthur Ernest Jolliffe, until his retirement with the title emeritus in 1936 professor of mathematics at King's College, London, died on March 17 at the age of seventy-three years.

The Board of Governors of the Institute of Medicine of Chicago has accepted the custody of a memorial fund collected by friends and associates of Sergius Arquin, who died while an intern at Cook County Hospital. The income from the fund is to be used as a prize for investigative work or as a contribution toward the cost of publication or illustration of such work or for related assistance in clinical research carried on by an intern or resident in Cook County Hospital or other local hospitals. Applications should be addressed to the Secretary of the Institute of Medicine of Chicago, 86 East Randolph Street, Chicago 1.

A plaque will be unveiled on May 24 to the memory of Samuel F. B. Morse on the day when he sent the first telegram from Washington to Baltimore one hundred years before. The plaque will be unveiled near the old Supreme Court room with a re-enactment of the scene in 1844 when Morse sent the first telegram over an experimental line to Baltimore. The original instrument is being loaned by Cornell University.

SCIENTIFIC EVENTS

THE SOVIET WORLD ATLAS

The Scottish Geographical Magazine writes as follows in regard to the World Atlas of the U.S.S.R.:

In the judgment of competent authorities this is the finest atlas which has ever been published. It is to be published in three parts: Part I is already issued, but Parts II and III, which were to have been issued in 1940, have been held up owing to the war.

The scholarship is thorough and the reproduction outstanding. The plates are beautifully printed by offset presses, and many of them use fifteen or twenty colors. The paper is rag stock and there is a special binding which makes it possible to remove individual maps. Editorial work cost five million roubles, while publication cost twenty million roubles more.

Volume I deals with the world as a whole and the Soviet Union as a whole. Some of the outstanding plates are the world maps of soils, natural vegetation, trade, national ownership of railways, population and mineral resources. There is a new climatic region map specially revised by Koeppen. A wealth of material also throws light on the resources of the Soviet Union. Many maps are double and triple page size.

Since the atlas is in Russian its use has naturally been very limited, but the Department of Geology and Geography of Syracuse University, New York, has come to the rescue and, with the assistance of two of their staff especially, have translated into English all the titles and legends of Volume I. These are now available in a lithoprinted book of 100 pages. Place names are not generally translated, but they are not considered essential, as the atlas deals largely with economic, cultural and physical aspects. No knowledge of Russian is needed to use the translation volume, as the appropriate symbol is shown opposite each item in the legend.

Volume II and Volume III, not yet published, deal, respectively, with the Soviet Union in detail and with foreign countries.

THE MAP OF JAPAN OF THE NATIONAL GEOGRAPHIC SOCIETY

The National Geographic Society has issued a map of Japan and adjacent regions. The exact mileage to Tokyo from the recently won island bases appearing on the edges of this map can be accurately measured. It is published as a ten-color supplement to the April issue of *The National Geographic Magazine* and is the most comprehensive general chart of Japan, eastern China, Manchuria and eastern Soviet Russia so far produced.

The map has been computed with Tokyo as its center. The exact spot is the central railway station, about which cluster the Imperial Palace, the Central Post Office and the Marunouchi Building, one of the city's largest office structures.

There are five large-scale insets—close-ups of industrial and strategic areas. These include the Tokyo-Yokohama-Yokosuka Navy Base region; the Nagoya manufacturing center; the tri-cities of Osaka, Kyoto and Kobe; the Shimonoseki area, where Honshu and Kyushu are joined by a railroad tunnel at the western end of the Inland Sea, Japan's Mediterranean, and the naval centers of Sasebo and Nagasaki. A sixth inset shows the entire Marshall Islands group, including American-held Kwajalein, Eniwetok, Wotho and Majuro atolls.

Railroads and roads are shown, recent dismantling due to the war is noted, and projected construction indicated. The usual table of geographic equivalents translates foreign-spelled geographic names into Eng-

lish. Chinese place-name spellings correspond with news dispatch usage.

The map was compiled from entirely new base material, and was welcomed by the Geographical Section of the General Staff, the Far Eastern Division of the Commerce Department and other Government offices which opened their files so that all information that had been collected might be put into usable form.

GRANTS OF THE ROCKEFELLER FOUNDATION FOR FUNDAMENTAL RESEARCH IN EUROPE

THE review for 1943 of the Rockefeller Foundation by President Raymond B. Fosdick includes the following account of its work in support of research in Europe:

It is gratifying to record that even in the war-shaken countries of Europe fundamental research in the biological and medical sciences has been kept alive. Nothing is known, of course, of the situation in Germany and in most of the occupied countries; but in Great Britain, in Sweden, in Switzerland and until recently in Denmark work on basic problems had been prosecuted without serious break.

In relation to many of these projects the Rockefeller Foundation has been able to be of assistance. Ever since the war started, uninterrupted support has been given, for example, to Svedberg's monumental work on proteins at the University of Uppsala and to Runnström's research in chemical physiology and embryology at the University of Stockholm. Dr. Svedberg is a Nobel prize winner, and the studies of both these men have deep significance for the future. In the earlier days of the war it was possible for the foundation to get funds to outstanding Danish scholars working at the University of Copenhagen. When these scholars were driven out of Denmark, support was continued for them in Sweden, where they had found refuge.

Similarly, aid to Swedish scholars has been given during the war for research in biochemistry, biophysics and neurophysiology at the Karolinska Institut; for studies in radiology at the Serafimer Hospital; and for work in radioactive substances at the Research Institute of Physics of the Academy of Sciences. In Switzerland the foundation has made grants to the University of Basel, the University of Zurich and the Eidgenössische Technische Hochschule for research in biochemistry, organic chemistry and plant physiology.

In Great Britain, grants—in relatively small amounts—cover a wide range of basic research in biochemistry, biophysics, genetics, organic chemistry, psychiatry, neurology and neurosurgery. This research is under way at Oxford, Cambridge, the University of Sheffield, the University of Edinburgh, the University of Birmingham, the Galton Laboratory and University College, London.

But it is not alone in the biological and medical sciences that these war-weary countries are maintaining the studies and research that look to the future and are thus keeping alive in Europe the high tradition of learning. In the social sciences as well a great deal of work is being carried on; and since the war began the foundation has had the privilege of making grants to organizations like the Royal Institute of International Affairs, the London School of Economics and Political Science, the National Institute of Economics and Social Research in London, the Social Studies Research Committee of Oxford, Political and Economic Planning (PEP)—as well as to the Swedish Institute of International Affairs and the Graduate Institute of International Studies at Geneva, Switzerland.

Sums have also been given to the delegates of the press of Oxford University for distribution as grants in aid among refugee scholars in England in connection with their research. The reports from Oxford indicate that the research has covered widely diverse fields, such as philosophy, history, mathematics, music, art and law. "I can give an excellent account of the industry, frugality and loyal spirit of those who have received grants," writes Kenneth Sisam, who has been in charge of the fund. "It is a scheme which has enabled scholars who could not take an active part in war work to make a valuable contribution to learning."

That fundamental research can be maintained in countries where the shock of war is ever present, and the lamp kept burning, is in these dark days a refreshing reminder of the power and persistence of creative intelligence.

THE VIRGINIA ACADEMY OF SCIENCE

THE twenty-second annual meeting of the Virginia Academy of Science will be held at Richmond on May 9 and 10. Seven of the eleven sections of the academy will hold meetings, including the sections of bacteriology, biology, chemistry, education, geology, physics and mathematics and statistical methods. It is expected that about seventy-five papers will be presented, many of them reporting the results of research during the past year.

At the evening session on May 9, after a dinner for members of the council, section officers and committee chairmen, the names of those to whom have been awarded the annual research prize for members and the Jefferson award will be announced. Officers for the coming year will be elected. Dr. Robert F. Smart, professor of biology and chairman of the Division of Sciences of the University of Richmond, will be installed as president.

Meetings of the sections will be held on May 10 beginning at 10 A.M. There will be a luncheon at 1 o'clock, during which the reports of the outgoing president and of the secretary of the academy, Dr. E. C. L. Miller, will be read. Following the meetings of the sections the Virginia Section of the American Chemical Society will give a dinner. An evening meeting has been arranged at which Dr. E. H. Hamann, chief chemist for Fritzche Brothers, New York City, guest lecturer, will speak on "The Production of Essential Oils in Various Countries." All members of the academy and the public are invited.

THE NATIONAL SCIENCE TEACHERS ASSOCIATION

THE formation of The National Science Teachers Association, "to stimulate, improve and coordinate science teaching at elementary, secondary and collegiate levels of instruction" has been announced by Dr. Philip G. Johnson, assistant professor of rural education at Cornell University, *president pro tem* of the new organization.

The association has been formed as the first step in a merger of two national science teachers organizations—the American Science Teachers Association and the American Council of Science Teachers. It is expected ultimately to have more than twenty-five thousand members representing all teachers of science. It will be affiliated with the American Association for the Advancement of Science and with the National Education Association.

Its general aims are:

To make the influence of science teacher organizations a potent force through the unification of their efforts.

To initiate and maintain a national effort by scientists and educators to the end that the sciences may be given a just and reasonable opportunity to serve the needs of all youth and adults.

To plan a long range program for the improvement of the teaching of science.

To assist scientists and science teachers to work together and have a voice with other groups, such as teachers in other subject matter fields, supervisors and administrators, in defining plans and policies for public education.

To stimulate wide-spread and intelligent cooperative action on problems related to the teaching of science.

The preliminary organization, which is to hold office until the merger is completed, or until December 31, 1944, was developed at a recent meeting in Pittsburgh, participated in by leaders of eleven national and regional groups interested in the advancement and improvement of the teaching of science.

Participating were Norman R. D. Jones, of St. Louis, president of the American Council of Science Teachers; Dr. Morris Meister, of New York City, president of the American Science Teachers Association; Emil L. Massey, of Detroit, president of the Central Association of Science and Mathematics Teachers; Professor Hugh C. Muldoon, of Pittsburgh, of the Catholic Conference of Science Teachers; M. A. Russell, of Royal Oak, Mich., president of the National Association of Biology Teachers; Dr. Reuben T. Shaw, of Philadelphia, of the Middle States Association of Science Teachers; W. H. Michener, of Pittsburgh, of the American Association of Physics Teachers; John C. Hogg, of Exeter, N. H., of the New England Association of Chemistry Teachers; Dr. Dwight E. Sollberger, of Indiana, Pa., of the American Nature Study Society; Laurence L. Quill, of Lexington, Ky., of the Division of Chemical Education of the American Chemical Society, and Dr. Johnson, of Cornell University and the Ithaca Public Schools, president *pro tem.*

Membership in the association will be open to all teachers of science, and to others interested. Provision is made for the affiliation of other groups. The headquarters of the association, for the present, will be at Cornell University.

MEDAL DAY OF THE FRANKLIN INSTITUTE

THE annual Medal Day ceremonies of the Franklin Institute of Philadelphia were held on April 19.

As already announced in SCIENCE, Franklin Medals were awarded to Dr. William David Coolidge, vice-president and director of research for the General Electric Company, and to Peter Kapitza, director of the Institute for Physical Problems of the Academy of Sciences, U. S. S. R.

The Francis J. Clamer Medal was awarded to Dr. Walther Emil Ludwig Mathesius, president of the Geneva Steel Company at Geneva, Utah, a former vice-president of the United States Steel Corporation, for "decidedly outstanding achievements in metallurgy and particularly for contributions in blast furnace practice."

Joseph Burroughs Ennis, senior vice-president of the American Locomotive Company, New York, received the George R. Henderson Medal for work in locomotive engineering and design.

Professor Stephen P. Timoshenko, of Stanford University, received the Louis E. Levy Medal for a paper entitled, "The Theory of Suspension Bridges," published in the journal of the institute.

Dr. Harvey Clayton Rentschler, director of research of the lamp division of the Westinghouse Electric and Manufacturing Company at Bloomfield, N. J., received the Frank P. Brown Medal "in consideration of his application of a source of bactericidal ultraviolet radiation in air conditioning systems."

SCIENTIFIC NOTES AND NEWS

DR. E. V. MCCOLLUM, of the School of Hygiene and Public Health of the Johns Hopkins University, is the first recipient of the Borden Nutrition Award given by the American Institute of Nutrition. The citation reads: "In recognition of his long years of pioneering research in nutrition. His contributions

to our knowledge of the vitamin content of milk and of the high nutritive value of 'protective foods,' one of which is milk, have served as foundation stones for improving through foods the nutrition and health of the human race."

DR. JOHN FAIRFIELD THOMPSON, executive vice-president of the International Nickel Company, has been awarded for distinguished engineering achievement the Egleston Medal for 1944 of the Alumni Association of the Engineering Schools of Columbia University. The medal was founded in 1939 on the occasion of the seventy-fifth anniversary of the School of Mines of Columbia University. It is given in memory of Professor Thomas Egleston, a pioneer in engineering education and for thirty-seven years a member of the faculty. The medal is awarded annually to an alumnus who distinguishes himself either in the furtherance of his branch of engineering, in the development of processes or techniques or in the application of engineering principles. The presentation was made on April 20 at the seventy-third annual dinner of the Alumni Association. Robert A. W. Carleton, president of the association, presented the award. Dr. Walter S. Landis, vice-president of the American Cyanamid Company, gave an address entitled "Sense and Nonsense in Post-war Planning."

A DINNER in honor of Dr. Arturo Castiglioni, professor of the history of medicine of the School of Medicine of Yale University, president of the New York Society for Medical History, was given in New York City on April 12. The dinner, at which he was presented with an anniversary volume, was in celebration of his seventieth birthday. Addresses of felicitation were made by Dr. John F. Fulton, of Yale University; Dr. Emanuel Libman, of Columbia University; Dr. Mario Voltera, formerly of Padua, Italy, and Dr. Henry E. Sigerist, of the Johns Hopkins University. The toastmaster was Dr. Iago Galdston, of the New York Academy of Medicine. The dinner was attended by two hundred of the friends and associates of Professor Castiglioni.

IN celebration of the seventy-sixth birthday of Dr. H. S. Jennings, professor emeritus of zoology of the Johns Hopkins University, now resident at the University of California at Los Angeles, the library of the university arranged an exhibit of his published works, which was on view from April 10 to 21.

DANIEL W. MEAD, emeritus professor of hydraulic and sanitary engineering of the University of Wisconsin, has been elected an honorary member of the Canadian Institute of Engineers.

DR. ROE E. REMINGTON has resigned as professor of nutrition and director of the Food Research Laboratory of the Medical College of the State of South Carolina, a post which he has held since 1928.

DR. FRED W. ELLIS, associate in pharmacology at the Jefferson Medical College of Philadelphia, has been appointed assistant professor of pharmacology in the School of Medicine of the University of North Carolina.

DR. ERLING W. HANSEN, assistant professor at the Medical School of the University of Minnesota, has been appointed clinical professor of ophthalmology and director of the division of ophthalmology.

DR. EDWARD M. BRIDGE, who has been associated for sixteen years with the Johns Hopkins University, has been appointed to a newly established professorship of pediatrics at the University of Buffalo, and has been made director of the department of research of the Children's Hospital under the joint auspices of the two institutions. The establishment of the research department was made possible by a grant of the trustees of the estate of the late E. M. Statler. The hospital is remodeling a floor of one of its buildings to house the laboratories.

DR. ROY R. KRACKE, professor of pathology and bacteriology and chairman of the department at the School of Medicine of Emory University, has been made dean of the Medical College at Birmingham, Ala. Dr. Stuart Graves, who has been dean of the school during the transition period of its development from a two-year school to a four-year college, will remain as dean of the basic medical sciences.

DR. ROLLA E. DYER, director of the National Institute of Health, which was recently raised to the rank of a bureau, has been made assistant surgeon general.

DR. ARTHUR OSOL, professor of physical chemistry and assistant dean of the Philadelphia College of Pharmacy and Science, chairman of the Philadelphia Section of the American Chemical Society, has been appointed a member of the Technical Advisory Service of the Science Advisory Committee of the Smaller War Plants Corporation.

DR. AVEN NELSON, emeritus professor of botany of the University of Wyoming, of which institution he has been a member since its beginning, is writing his memoirs. Mrs. Aven Nelson has been appointed assistant in the Bebb Herbarium of the University of Oklahoma.

DR. VIRGINIO MANGANIELLO, vice-director of the Astronomical Observatory at La Plata, Argentina, has been appointed director.

ROBERT S. ARCHER, chief metallurgist of the Republic Steel Corporation, of the Chicago District, has

joined the Climax Molybdenum Company as metallurgical assistant to the vice-president.

THE British Council has appointed Dr. P. M. Roxby, professor of geography at the University of Liverpool, to be its principal representative in China. Accompanied by Mrs. Roxby, who is lecturer in history at the university, he will take up his work in China early in 1945.

DR. WALTER J. NICKERSON, head of the department of botany at Wheaton College, Massachusetts, has leave of absence. He is now a lieutenant in the Sanitary Corps assigned to the Physiological Test Section, Proof Department, Eglin Field, Fla.

COLONEL RICHARD P. STRONG, director of tropical medicine at the Army Medical School, Washington, D. C., on March 13 delivered the Julius J. Selman Lecture at Mount Sinai Hospital, Cleveland. His subject was "Tropical Diseases in Relation to the Present War." On the same day he gave a lecture at Western Reserve University entitled "The Pandemic of Plague of the Twentieth Century and Some of the Present Problems Regarding It."

DR. HARLAN T. STETSON, director of the Cosmic Terrestrial Research Laboratory at Needham, Mass., addressed the Geological Section of the New York Academy of Sciences on April 3 on "Modern Evidences for Differential Movement of Certain Points on the Earth's Surface."

DR. HENRY E. SIGERIST, professor of the history of medicine at the Johns Hopkins University, and Dr. C.-E. A. Winslow, professor of public health at the School of Medicine of Yale University, took part on April 14 in a discussion arranged by the Physicians Forum at the New York Academy of Medicine on "Doctor and Patient under a System of National Health Insurance," as proposed in the Wagner-Murray-Dingell Bill.

A SERIES of lectures on popular science and technology is being given from April 7 to May 26 at the Museum of Science and Industry, Chicago. Dr. Milan V. Novak, professor of bacteriology and public health at the College of Medicine of the University of Illinois, gave the first lecture on penicillin. On April 28, Dr. Ralph W. Gerard, professor of physiology at the School of Medicine of the University of Chicago, will speak on "The Biological Aspects of War and Peace," and on May 5, Dr. Andrew C. Ivy, Nathan Smith Davis professor of physiology and head of the department at the Medical School of Northwestern University, will give a lecture entitled "Aviation Calls the Doctor."

A SYMPOSIUM on degenerative diseases, jointly sponsored by the Research Unit of the St. Louis City Infirmary and the School of Medicine of Washington University, was held in St. Louis on March 24 and 25. The speakers included W. C. Hueper, New York, "The Relation Between Etiology and Morphology in Degenerative and Sclerosing Arterial Diseases"; Irvine H. Page, Indianapolis, "Arteriosclerosis and Lipid Metabolism"; William B. Kountz, St. Louis, "Current Research on Degenerative Diseases at the St. Louis City Infirmary"; Albert Kuntz, St. Louis, "Effects of Lesions of the Autonomic Ganglia and Centers, Associated with Age and Other Disease, on the Vascular System"; Lester R. Dragstedt, Chicago, "The Role of the Pancreas in Arteriosclerosis"; Edward J. Stieglitz, Washington, "Difficulties in Clinical Recognition of Degenerative Diseases"; William J. Kerr, San Francisco, "Correlation of Clinical Knowledge in the Treatment of Degenerative Diseases"; William deB. MacNider, Chapel Hill, N. C., "Age Change and Adjustment"; John A. Saxton, St. Louis, "Nutrition and Growth and their Influence on Longevity in Rats"; and Leo Loeb, St. Louis, "Some Hormone Actions in Relation to the Aging Process." This symposium will be published as Volume XI of Biological Symposia.

THE annual general meeting of the American Philosophical Society, Philadelphia, opened on Thursday, April 20, with a symposium on war-time advances. The meeting will continue through Friday and Saturday.

THE two hundred and sixtieth meeting of the American Physical Society will be held at the Mellon Institute, Pittsburgh, on Friday and Saturday, April 28 and 29. There will be a joint meeting with the Physical Society of Pittsburgh, which has arranged a program on the physics of metals on Friday morning. The new Division of Electron and Ion Optics with I. I. Rabi, *Chairman;* L. Marton, *Vice-chairman,* and J. R. Pierce, *Secretary,* has assembled a group of papers in its field, which will be given on Saturday morning and afternoon. A symposium on cosmic rays will be held on Friday afternoon. Two groups of invited papers, including two on the philosophy of physics, are planned for Saturday. Contributed ten-minute papers, other than those on the program, will be given in four sessions on Friday and Saturday.

IT is planned to hold in June two regional meetings of the American Association of Physics Teachers—one at Cincinnati, Ohio, from June 22 to 25, jointly with the Society for the Promotion of Engineering Education, and one in Rochester, N. Y., on June 23 and 24, concurrently with a meeting of the American Physical Society. A symposium is being arranged dealing with the general application of physical principles in military areas and a program of invited papers on the post-war training of physicists.

THE National Committee for Mental Hygiene announces the establishment of a fund for research in psychosomatic medicine. The purpose is to stimulate and subsidize research in the psychosomatic aspects of the diseases chiefly responsible for disability and death. The fund will be directed by Dr. Edward Weiss. Projects will be considered by the following committee: Dr. Charles M. Aldrich, Dr. Franz Alexander, Dr. Stanley Cobb, Lieutenant Colonel William C. Menninger and Dr. John Romano. It will be administered under the direction of Dr. George S. Stevenson, The National Committee for Mental Hygiene. Communications should be addressed to Dr. Edward Weiss, 269 South 19th Street, Philadelphia 3, Penna.

PRESIDENT ROOSEVELT signed on March 30 a bill authorizing the U. S. Department of Agriculture and the Department of the Interior to make cooperative agreements with private forest owners for the establishment of forest units of sustained-yield by which the owners would make an agreement to manage their lands in accordance with certain regulations governing the rate, manner and time of cutting.

IT is reported in *Nature* that the British Institution of Radio Engineers recommends the formation of a British Radio Research Institute, the functions of which would be the pursuit of basic research of the type that has hitherto suffered restriction owing to its high cost, absence of obvious or immediate practical applications, and the poor prospect of early financial returns. It is proposed that the institute be financed by industry supplemented by a Government grant of at least equal amount. The work would be directed by a board representing governmental authorities, the British Broadcasting Company and the Services, the industry, the British Institution of Radio Engineers, the associated professional institutions and the universities of the Empire. In addition to a permanent scientific staff, the assistance and engagement of extramural workers would be arranged in cooperation with industry and the universities.

DISCUSSION

THE THIRD ANNUAL SCIENCE TALENT SEARCH[1]

How do young people develop into great scientists? Can we discover them and then analyze the growth of their scientific careers? A partial answer to such questions is found in the follow-up study now under way concerning participants in the annual Science Talent Search.[2]

This genetic study of science talent is now in its second year, involving the 3,175 contestants with complete entries for 1942, and the 3,481 contestants with complete entrance materials of 1943. Of the 3,175 follow-up questionnaires sent out in January, 1943, to the 1942 contestants, 2,475 or 78 per cent. were returned, and all the information has since been reduced to punch cards. From these data it is known that of the boys who returned questionnaires, 97 per cent. of the winners, 87 per cent. of the "honorable mentions" and 76 per cent. of the other participants had started college. Among the girls, 89 per cent. of the winners, 92 per cent. of the "honorable mentions" and 70 per cent. of the other participants had begun college. Of 216 in the group of trip winners and "honorable mentions" who returned questionnaires, 100 (77 boys and 23 girls) reported scholarships from various sources, the aggregate sum of which is $68,988.98.

Annual surveys of the entrants in the first and second contests are planned for at least the next ten years to learn something about the growth of scientists—"how they get that way"—and to give broad information concerning their social, physical and intellectual development. The results should provide valuable data for bettering the educational planning of talented young people who are potential scientists, as well as supply a basis for judging the validity of the selection procedures.

The selection techniques this year—in the Third Annual Science Talent Search—were quite like those previously.[3] Of about 15,000 entrants, complete entry materials—science aptitude examination, personal data, scholarship record and scientific essay—were received on about 3,000. This group of high-school seniors, then, were considered to have completed the first hurdle.

The science aptitude examination differed from previous years in that only half of it consisted of a paragraph reading test on materials from various fields of science; the other half was composed of scientific problems, with multiple choice answers. Scores on the paragraph material constituted the second hurdle, scores on the problems the third hurdle. The second hurdle reduced the number of contestants from ap-

[1] The opinions or assertions contained herein are the private ones of the writers and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.

[2] The annual Science Talent Search is conducted by Science Clubs of America and Science Service, and is financed by the Westinghouse Electric & Manufacturing Company.

[3] *Cf.* Harold A. Edgerton and Steuart Henderson Britt, *American Scientist*, 1943, 31, 55–68; *American Scientist*, 1943, 31, 263–265; *Occupations*, 1943, 22, 177–180; "Science and the Future," Washington, D. C., Science Service, 1943, 112–115.

proximately 3,000 students to 812. Of these, 580 were boys and 232 girls, the proportion being in the ratio of the boys and girls with complete entrance materials. The third hurdle eliminated 214 more contestants, leaving 409 boys and 189 girls in the running.

The fourth hurdle was based on the academic record of the individual; the high-school record "composite" score was the sum of relative rank in high-school class and units of high-school science taken, weighted 5:1 respectively. The 450 highest (308 boys and 142 girls) were deemed to have passed this hurdle.

The fifth step was an evaluation of the recommendations made by high-school faculty members.[4] Five trained raters scored this information in terms of specific actual accomplishments; and on this basis the population was then reduced to 207 boys and 93 girls —containing the 40 trip winners and the 260 students who were given honorable mention.

The essays of these 300 were read separately and scored by three members of the staff of Science Service. Every contestant had written an essay of about 1,000 words on the subject, "My Scientific Project," telling what he or she is doing or plans to do in science in the way of experimentation or other research activity.

At this point, on the basis of all the evidence thus far accumulated—the two sets of scores on the science aptitude examination, high-school record, recommendations and essay—the present writers then made a selection of the 40 trip winners to the Science Talent Institute held in Washington, D. C., 28 boys and 12 girls. *The names and geographical localities represented were completely unknown,* for this information had been blanked out so that identification was by serial number only. Also, no questions concerning either race or religion appeared in any of the forms used.

The final selections, from among the trip winners, of the 2 winners (a boy and a girl) of the $2,400 scholarships and the 8 winners (6 boys and 2 girls) of the $400 scholarships, were made with Dr. Harlow Shapley, director of the Harvard College Observatory and chairman of the executive committee of Science Service, acting as the third judge. These decisions were based on the "over-all" previous evidence, plus information obtained from individual, standardized 15-minute interviews specially designed to determine how well the contestant is fitted for a promising career in science. Scores on the Bennett Mechanical Aptitude Test,[5] which was administered at the Science Talent Institute, were also considered, as well as personality data obtained in an additional interview by a psychiatrist.

The 40 finalists this year are residents of the following states: Alabama, 2; Arizona, 1; California, 1; District of Columbia, 1; Florida, 1; Georgia, 1; Illinois, 2; Michigan, 1; New Jersey, 3; New York, 14; Ohio, 3; Pennsylvania, 3; Virginia, 1; West Virginia, 1; Wisconsin, 4; and Wyoming, 1.

The scholarships permit the winners to go to any college, university or technical school of their own selection for training in science or engineering; courses that may be pursued are those encompassed in the fields of activity of the National Academy of Sciences and the National Research Council. Eleven of the trip winners in this year's Science Talent Search hope to do research in biology, chemistry, medicine or physics; three want to be electronic engineers; two expect to become theoretical chemists, and one a mathematical physicist. Other choices of probable fields of study range from naval architecture to biochemistry. The careers of these trip winners will be carefully followed.

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[4] *Cf.* Edgerton and Britt, *Occupations, op. cit.*

[5] George K. Bennett and Dinah E. Fry, "Test of Mechanical Comprehension," Psychological Corporation, 1941.

CONCERNING "GENOTYPES"

OF recent years there have grown up in both botany and zoology two uses of the word "genotype." That with a longer history is clearly defined in B. Daydon Jackson's "Glossary of Botanic Terms" as "the type of a genus, the species upon which the genus was established." But the usage which is now becoming prevalent is that of "a combination of the genes of an organism." Although the two terms come into little conflict, the former being employed by taxonomists and the latter by geneticists, I have noticed an increasing tendency for taxonomic workers to substitute for this word the phrase "type species." It is well in science to employ such terms as "genotype" with a single unequivocal meaning.

While priority sanctions the taxonomic use of the word, etymology does not. "Genotype" in the genetical sense is based simply and properly upon the Greek γένος, meaning "race" or "offspring," but in the taxonomic sense it is based upon the Latin "genus" (as employed in modern science), the stem of which is not "gen" but "gener." Etymologically, the compound of "genus" with "type" should be "generitype" rather than "genotype." We have the right formations in the adjectival "genic" and "generic"; every one recognizes that genic differences are between genes, while generic ones are between genera.

I suggest that the situation be cleared by taxono-

mists replacing the ill-formed word "genotype" by the correctly formed "generitype." This course will not only avoid a needless conflict of terms, but actually will give us a more satisfactory word.

Francois W. Pennell

TRANSLITERATION OF RUSSIAN NAMES

Contributors to the recent correspondence on the transliteration of Russian names appearing in Science, Vol. 97, p. 243; Vol. 98, pp. 132, 133, seem to be unaware of the fact that the Russian Academy of Sciences had already adopted a system of transliteration as far back as 1906. This Latin transcription of Russian names—which is based on the Czech alphabet—is still being used in the publications of the academy.

In view of this, it would be advisable (as I have already pointed out more than twenty years ago, in *Nature,* Vol. 110, 1922, p. 279) for all countries to conform to the rules already set forth by the Russian Academy, instead of attempting to devise their own systems. This is desirable because, in the event of Russia adopting the Latin alphabet for general use, the task of formulating the rules will probably be entrusted to this institution, as the highest authority in the country.

The original rules were reproduced in *Nature* of May 14, 1908, p. 42. As they might not be accessible at present and as they do not comply with the new orthography introduced about twenty-five years ago, I have set forth the revised transliteration, which is as follows:

А, а = a	Л, л = l	Ц, ц = c
Б, б = b	М, м = m	Ч, ч = č
В, в = v	Н, н = n	Ш, ш = š
Г, г = g	О, о = o	Щ, щ = šč
Д, д = d	П, п = p	Ъ, ъ = ’
Е, е = e, je	Р, р = r	Ы, ы = y
Ж, ж = ž	С, с = s	Ь, ь = j
З, з = z	Т, т = t	Э, э = e
И, и = i	У, у = u	Ю, ю = ju
Й, й = j	Ф, ф = f	Я, я = ja
К, к = k	Х, х = ch	

C. A. Hoare

The Wellcome Research Institution,
London, England

SCIENTIFIC BOOKS

HANDBOOK OF MEDICAL ENTOMOLOGY

Insects of Medical Importance. By John Smart. With chapters on Fleas by Karl Jordan and on Arachnids by R. J. Whittick. 269 pp. British Museum, London.

The application of science in the field by our military forces has presented many difficulties, especially in the realm of biology as related to medicine and in matters pertaining to public health. Suddenly a great need arose for a large personnel acquainted with the practical phases of these subjects. Extensive training has been successfully undertaken, but there has existed a real lack of useful handbooks to aid those who could not enjoy the academic atmosphere of libraries and laboratories. In no field, perhaps, has it been more difficult to meet the demand for competent workers than in medical entomology. In many countries the danger from insect-borne diseases such as malaria, bubonic plague and typhus is ever present, while the prevalence of others like typhoid fever and cholera is greatly augmented through the activities of particular insects.

The present book is an attempt to present in brief form material that will enable workers who lack extensive training in taxonomic entomology to recognize and determine with some degree of certainty those insects that menace the public health in the several war zones of the Old World.

By reason of the paramount importance of malarial fevers a major part of the text and illustrations is devoted to a consideration of the species of anopheline mosquitoes, with keys for their identification both as larvae and adults. This section includes over 70 pages with many fine drawings of anatomical details. The numerous species are grouped geographically as Palaearctic, Ethiopian, Oriental and Australian and extensive notes are presented to correlate these larger areas with specific places or borderland countries. Such an arrangement should be especially helpful in dealing with this large complex, in which only a small proportion of the species are important vectors of malaria, despite their close structural similarity. Ecological notes on breeding places are included. There is a general review of the other blood-sucking Diptera with a table for the recognition of the several important families and more complete accounts of some groups. Thus, the gad-flies (Tabanidae) and the African tsetse flies are treated more extensively, especially the latter. A general account of Dipterous larvae that invade the body is given in a section on myiasis, together with enumerations of blow-flies and maggots that may occur in foods. To all sections frequent bibliographic references are appended in the form of footnotes.

A section on fleas, written by Dr. Karl Jordan, will prove valuable, although it is far less complete than the part on mosquitoes.

In any such compendium much must necessarily be omitted and the material that is included requires careful selection to avoid serious gaps. Dr. Smart has quite consistently passed over all reference to groups that are of zoological interest only, which means, of course, that the greater part of the book deals with the Diptera. Aside from insects, there are several short accounts of some other arthropods, mainly mites and ticks.

Although this book was prepared and printed in England, under the most trying conditions and undoubtedly in considerable haste, the material is singularly well selected, carefully prepared and beautifully printed on first-class paper. It may be heartily recommended, especially to entomologists overseas as a brief, practical aid in the identification of disease-bearing insects. The one really serious defect is the very incomplete and wholly inadequate index.

CHARLES T. BRUES

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CHEMISTRY OF ORGANIC MEDICINAL PRODUCTS

The Chemistry of Organic Medicinal Products. By GLENN L. JENKINS and WALTER H. HARTUNG. Second edition. vi + 675 pp. John Wiley and Sons, Inc., New York; Chapman and Hall, Ltd., London. October, 1943. $5\frac{3}{4} \times 8\frac{1}{2}$ in. \$6.50. Bound in dark-red cloth.

THAT a second edition of this book should appear only two years after the first one (reviewed in SCIENCE, n.s., 96, 516; December 4, 1942), indicates that there is a considerable demand for a compact yet comprehensive treatment of this exceedingly interesting and rapidly expanding field, and that this particular work has met with favor.

On the material side, the new edition differs from the old in being printed instead of planographed, and bound in cloth in place of stiff paper. To provide space for the supplementary information given, including a wholly new chapter on "Some Physicochemical Properties of Medicinal Products," over 200 pages have been added. The former text has been thoroughly revised and some chapters completely rewritten.

In other respects, the book remains much the same, and should prove helpful to both chemists and medical men who wish to refresh their memories on the older drugs and learn something about the newer ones, for it includes methods of preparation, properties, uses and modes of administration.

MARSTON TAYLOR BOGERT

COLUMBIA UNIVERSITY

ORGANIC CHEMISTRY

Laboratory Practice of Organic Chemistry. By G. ROSS ROBERTSON. x + 369 pp. Illustrated. Macmillan Company. 1943. \$2.50.

THE author has presented an excellent laboratory manual for the beginning organic chemistry student. Part I, containing chapters 1–16, introduces the most thorough and clearly organized theoretical development the reviewer has seen in any organic laboratory manual. The thorough drilling in the theory and techniques of the elementary laboratory practice should help to eliminate the "cook-book" chemist in the majority of beginning organic students.

Part II introduces detailed instructions for fifty-nine typical and well-selected experiments in organic chemistry. The experiments are designed to cover both the aliphatic and aromatic series, and experiments may be chosen from both series to be applied to a one-semester course primarily for premedical students.

The reviewer feels this revised edition is one of the best beginning organic laboratory manuals available.

ROBERT G. LINVILLE

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MATHEMATICAL PHYSICS

Methoden der Mathematischen Physik. By R. COURANT and D. HILBERT. 2 volumes. Interscience Press. By permission of the Alien Property Custodian. \$8.00 each; \$14.00 the pair.

THE two volumes by Courant and Hilbert are already widely known among mathematicians and physicists for their clarity, rigor and breadth of view. They constitute an outstanding source of material on expansion methods and partial differential equations. American mathematical physics will be benefited both during the war and after by having them available at a greatly reduced price.

American mathematics is being further served by the republication, also under authority of the Alien Property Custodian, of such other standard works as Doetsch, "Theorie und Anwendung der Laplace-Transform" (Dover); Frank-von Mises, "Differential und Integralgleichungen der Mechanik und Physik" (Rosenberg); Hilbert-Bernays, "Grundlagen der Mathematik" (Edwards); Jahnke-Emde, "Funktionentafeln mit Formeln und Kurven" (Stechert, Dover); Kellogg, "Potential Theory" (Murray); von Neumann, "Mathematische Grundlagen der Quantenmechanik" (Dover); Peters, "Siebenstellige Werte der Trigonometrischen Funktionen" (Edwards); van der Waerden, "Moderne Algebra" (Ungar).

GARRETT BIRKHOFF

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REPORTS

THE AMERICAN ACADEMY OF TROPICAL MEDICINE[1]

IN view of the importance of tropical medicine in our present activities in tropical war theaters and in view of the world-wide significance of the problems involved now and in the immediate future, it has seemed desirable that the program and recommendations of the American Academy of Tropical Medicine, which have been prepared on request and have been unanimously endorsed by the academy and approved by the American Foundation for Tropical Medicine, be placed on record for the scientific public. Since no scientific organ has as wide-reading public as does SCIENCE, it is appropriate that this report should appear in full in this journal.—ERNEST CARROLL FAUST, *Secretary, American Academy of Tropical Medicine.*

I

INTRODUCTION

At the tenth annual business session of the American Academy of Tropical Medicine, held in Cincinnati on November 17, 1943, the following resolutions were adopted:

1. That the president be authorized, with the advice and consent of the council, to appoint a committee to clarify the relations of the academy to the foundation's program, and to make specific recommendations in order to activate the provisions of the constitution of the academy with respect to education and research in tropical medicine in the United States and in the international field.
2. That the council be authorized to take action on behalf of the academy on the report of this committee and to implement such of the recommendations as may seem advisable.
3. That the council be instructed to recommend to the foundation support of the program to be developed.

Following the adoption of the resolution by unanimous vote, President L. W. Hackett announced the appointment of the following persons as members of the committee: Dr. N. Paul Hudson; Dr. Alfred C. Reed; Dr. Wilbur A. Sawyer, *Chairman;* Brigadier General James S. Simmons; Dr. R. E. Dyer; Dr. George C. Shattuck; Dr. E. C. Faust, *Secretary.*

At noon on the following day a brief meeting of the committee was held between sessions of the American Society of Tropical Medicine. By invitation Dr. T. T. Mackie, president of the American Foundation for Tropical Medicine, met with the committee. It was agreed that the several members would send in suggestions and that the chairman thereafter would prepare a tentative draft of a report and submit it for amendment and correction and finally for adoption by mail vote. Dr. Mackie emphasized the need of the foundation for the academy's recommendations as to program and urged that they be made available by the middle of January.

A few days later, on November 20, 1943, Dr. E. C. Faust, secretary of the academy and member of the committee, wrote to the members asking them to send their views on the questions before the committee to the chairman without delay. All members had been heard from by December 20, 1943.

The questions before the committee are two: (1) What is, or should be, the relation of the academy to the foundation's program? (2) What program of education and research will the committee submit to the council of the academy for recommendation to the foundation?

II

THE RELATION OF THE ACADEMY TO THE PROGRAM OF THE FOUNDATION

The constitution of the American Academy of Tropical Medicine contains the following statement of purposes as formulated when the academy was organized in 1934:

Purpose: The purposes and aims of The American Academy of Tropical Medicine, Incorporated, shall be:

1. To further the extension of knowledge for the prevention of human and animal diseases of warm climates by stimulating interest, inquiry and research into their distribution, causes, nature, treatment and methods of control.
2. Through designated committees in the several fields of knowledge contributing to tropical medicine, to provide a current survey of work in progress in tropical medicine and sanitary and hygienic work related thereto.
3. To coordinate American work in tropical medicine to the end that unnecessary duplication and overlapping shall be avoided as far as possible, and that valid lines of study shall not be neglected.
4. To function as a central source of information for the advantage of investigators in this field of knowledge.
5. To cooperate with other agencies interested in maintaining and obtaining support for tropical medicine, both in a financial way and to the end that the medical professions, the general body of scientific workers and the general public may be better informed regarding the values and needs of tropical medicine in national and international programs.
6. To receive funds and administer them through grants-in-aid and in support of definite projects related to the purposes and aims of the academy as set forth in paragraph 1.

Although paragraph 6 of the "Purposes" suggested that the academy would receive funds and administer them in support of projects, etc., it appears that from the beginning it was recognized that the academy as a scientific body would not interest itself in soliciting funds from the public for tropical medicine, and there-

[1] Report of the committee on the relations of the academy to the program of the American Foundation for Tropical Medicine and on recommendations to the foundation for a program of education and research.

fore the formation of a foundation was suggested.[2] The suggested foundation was to be made up essentially of an executive group as contrasted to the scientific group in the academy. Dr. McKinley, in a letter which he quotes in the above-mentioned brochure, states that "Once the directorate of the Foundation of Tropical Medicine is created this new organization will proceed to raise funds to support work in this field of medicine." At that time it was plainly the purpose to have the academy and the foundation in close relationship, one preparing the program for developing the field of tropical medicine and the other, composed largely of executives of interested institutions, soliciting, holding and distributing the funds. Nevertheless, there was no mention of the Academy of Tropical Medicine in the certificate of incorporation or the by-laws of the foundation and the latter provided for a medical committee to make recommendations as to the medical value of projects. The general purposes of the foundation were similar to those of the academy, but more emphasis was placed on financial powers. The first directors were predominantly university presidents and other laymen.

With the passage of time the composition of the membership of the foundation changed and more medical men were included. The relationship to the academy, which had never been formally recognized, became less intimate and certainly more obscure. The following extract from a letter of the secretary of the foundation, Alfred R. Crawford, dated December 23, sums up the situation:

It seems clear, especially from the brochure, that it was originally intended that the foundation should be the fiscal and fund-raising body of the academy. The fact that Dr. McKinley was named the first executive director of the foundation when it was originally organized testifies to this intention. It appears that there would be interlocking boards of directors and a close identity of operations. These conditions may have obtained in the original foundation. As you know, the death of Dr. McKinley cut short the realization of the ambitious plans he had and since the reorganization of the foundation there has been no formal and little informal contact between the foundation and the academy and society.

The move to have the society and the academy name representatives on the board of directors of the foundation was taken on the initiative of the foundation during the past year. This was stressed at the meeting of the council of the academy in Cincinnati. The informal affiliation would, it was felt, be a means of identifying the foundation more closely with the work of the two related organizations and make it more truly the instrument which its originators had in mind.

I would judge the feeling of the group of council members who discussed this matter in Cincinnati to be somewhat along these lines:

1. That the foundation should maintain an independent status though be guided by the academy and society.

2. That this be accomplished by representation of the society and academy on the foundation's board of directors. Dr. Faust was named the society's representative and will be elected at the meeting in February. Dr. Shattuck, who is already a director, has been, we understand, recommended as the academy's appointee.

3. That the foundation shape its program around recommendations formulated by a joint committee of the academy and society which would define the general type of teaching, research or allied work which the foundation should undertake to finance.

4. That the liaison be further strengthened by active assistance in such matters as selections for fellowships and through constant reference and interchange of information.

Following Dr. McKinley's death, Dr. T. T. Mackie was designated the official representative of the academy in the Foundation for Tropical Medicine. After Dr. Mackie was elected president of the foundation, Dr. G. C. Shattuck was nominated as representative of the academy on the foundation's board of directors (letter of Mr. A. R. Crawford of December 30, 1943).

The division of function between the academy and the foundation at the present time seems clear. The foundation's board of directors, on which the academy and the Society of Tropical Medicine will be represented, has full responsibility for negotiating and approving projects and appropriating available funds for their support. The academy, through its committees and council, is expected to express its opinions as to desirable developments in the field of tropical medicine and give the foundation the benefit of its judgment, when requested, as to the wisdom of going into specific projects. The foundation, unlike the academy, could maintain and finance the staff necessary to negotiate and investigate proposed projects and to determine the amounts and conditions of appropriations. It would seem unwise for the academy to operate even an information bureau, since the most reliable advice in response to miscellaneous questions could be made available by reference to the institutions and individuals most qualified to reply. In brief, the academy can accelerate progress in the field of tropical medicine by making authoritative pronouncements as to the needs in that field, by recommending general programs to the foundation when requested, by answering inquiries as to the advisability of specific projects of the foundation in their general features, and by giving moral support to the movement to improve teaching and research in tropical medicine, both curative and preventive.

In the present instance it is evident that the advice

[2] Brochure on "The Development of Tropical Medicine in the United States," by Dr. E. B. McKinley, 1930, pp. 24–26.

of the academy with regard to program is invited by the foundation as its president, Dr. T. T. Mackie, has stressed to the committee the desire for early submission of suggestions for consideration by the foundation.

(1) *It is recommended* that the academy, while recognizing the independent status of the American Foundation for Tropical Medicine, respond to any invitation from the foundation for suggestions regarding its program by the submission of reports of appropriate committees through the council; and that, in case the invitation should be directed to the American Society of Tropical Medicine as well as the academy, the suggestions be prepared by a joint committee and submitted through the councils of the society and academy.

III

Suggestions for the Program of the Foundation

The mandate to the committee, as expressed in the resolution authorizing its appointment, was in part "to make specific recommendations in order to activate the provisions of the constitution of the academy with respect to education and research in tropical medicine in the United States and in the international field." The academy's principal opportunity to advance education and research at this time would seem to be through sugestions to the foundation with regard to its program.

The committee bases its recommendations on its firm belief that tropical medicine will increase in importance to the United States after the war. The military necessities have revealed the inadequacy of the previous training of medical men in tropical medicine in this country. Emergency courses and field experience for military medical men and teachers in medical schools have been sponsored by the Army Medical School and private agencies but are not expected to continue after the urgent military need has passed. There is now great wartime activity and expenditure of funds in foreign countries in health and other fields by our government and institutions. The effect has been to bind these countries more closely to the United States and to lead the other American countries to look in this direction for postgraduate instruction in medicine and tropical diseases, as they once looked to Europe.

The committee is of the opinion that the main emphasis of the foundation in its program should be on the stimulation, expansion and improvement of facilities for graduate and undergraduate instruction in tropical medicine in the United States.

In the graduate field there should be strong schools or departments of tropical medicine for postgraduate instruction of medical men who are intending to teach tropical medicine or to practice it in this country or abroad. Such schools or departments should be in university centers containing schools of medicine and public health with teaching hospitals and practice fields and should have close relationship to departments of engineering and nursing. Ties to schools in the nearer tropics would be an additional advantage. The schools or departments of tropical medicine would be closely linked to the medical schools in the teaching of clinical tropical medicine and to the schools of public health in the even more important subject of disease prevention. The organized teaching in tropical medicine would need to go far beyond existing instruction in medical schools and in most schools of public health with respect to certain biological branches of learning related to the epidemiology of tropical diseases, such as protozoology, entomology and helminthology. Attention should also be given to the scientific consideration of the effects of geography, climate, racial composition, nutrition and social conditions on the epidemiology of disease in the tropics. Most certainly the prevention of disease, the suppression of disease-carrying insects and the prevention of the transportation of insect vectors between countries should be given careful consideration. Rapid transit is one of the factors which has brought this country closer to the tropics and made it more vulnerable to tropical diseases. The adequate teaching of epidemiology and biostatistics is fundamental.

(2) *It is recommended* that the foundation assist or bring into being a strong school or department of tropical diseases in each of the following regions of this country—the South, the Atlantic Seaboard and the Pacific Coast.

Comment: For the South the present support to postgraduate instruction at the department of tropical medicine of Tulane University should be continued and increased sufficiently to permit the sending of students to tropical Mexico for field experience and to justify the granting of a diploma in tropical medicine and public health. For the Atlantic Seaboard and the Pacific Coast the committee is not ready to make a statement of preferred institutions or cities, but the selection should depend to a considerable extent on the actualities or early prospects of adequate provisions for teaching medicine and public health in the centers under consideration. Consideration should be given to the strengthening of the School of Tropical Medicine in Puerto Rico now affiliated with Columbia University.

The schools or departments of tropical medicine would be expected to draw students from tropical America as well as from the United States. Taking special interest in foreign students from the tropics they would see that these students obtained the required medical and public health training under favor-

able conditions. Such students may need special language instruction and supervision during the early months of their studies, and racial factors may determine in part which school and community would be most favorable.

The subsidies to these schools should contain sums for research by faculty and advanced students, both at their institutions and in the tropics. The cost of travel makes foreign investigations and research expensive, but there is no question that productive field research adds to the prestige and value of the schools. If faculty members can cooperate with the health authorities of tropical countries in important investigations, without causing additional expenses to the foreign governments, they are usually welcome.

(3) *It is recommended* that the foundation make available grants-in-aid to competent investigators in important problems of tropical medicine, the research to be carried on within or without the schools and departments otherwise assisted, and inside or outside the United States.

Comment: The offering of grants-in-aid is an established technic of philanthrophic foundations. In this case it would imply that the Foundation for Tropical Medicine, through its own staff and its advisers, would be in a position to make competent decisions, in each field in which grants are given. The object of the grants-in-aid would be to produce needed knowledge through research while that of fellowships would be training for future service.

(4) *It is recommended* that the foundation establish a moderate but flexible number of fellowships and travel grants for graduate students from the United States or foreign countries and for teachers or prospective teachers of tropical medicine in the United States or abroad, and that the study be either in the United States or abroad, but that the fellowships be granted only under conditions as to future service by the individual, and that prospective students be interviewed by or for the officers before the fellowships are granted.

Comment: The study and observations under such fellowships or travel grants could be in the United States or in a foreign country, and should be wherever the opportunities are best. In some cases travel grants without stipend would be the most appropriate form of assistance, as the employing institution may be able to continue salary, but not to provide travel.

(5) *It is recommended* that undergraduate instruction in tropical medicine in medical schools be assisted by the foundation through fellowships to the teaching staff and through making available teaching materials, and in some special cases by grants-in-aid; and that opportunity be given key technicians of diagnostic laboratories of public health departments or hospitals to receive instruction in the diagnosis of tropical diseases under a special type of travel grant or fellowship.

It is recommended that assistance be given by the foundation to the *American Journal of Tropical Medicine* and the *American Journal of Parasitology.* The committee understands that the former is now on a self-supporting basis as a bimonthly journal, but it believes it would facilitate the spread of knowledge regarding tropical medicine here and abroad if the *American Journal of Tropical Medicine* could be issued monthly and could contain new departments for editorials, reviews, communications, etc., after the restrictions on paper have been removed. These journals are regarded as educational mediums and are therefore considered here.

(6) *It is recommended* that the exchange of professors between foreign teaching institutions of tropical medicine and those in the United States be arranged and subsidized at least to the extent of furnishing travel costs when not otherwise provided.

Comment: It should be kept in mind that some of the best places for study, experience and research are outside this hemisphere, *e.g.*, in Singapore or Calcutta, and should be considered as possible places of study along with the American tropical countries. To help foreign tropical countries to educate their own nationals in tropical medicine, while sending the most promising graduates abroad for supplementing training and experience, should be the ultimate educational objective, but in the meanwhile a considerable number of graduate students should be brought here from the tropics for more basic postgraduate training. Any idea that many United States physicians could find opportunities in practice in tropical medicine in foreign countries, is probably mistaken and should be corrected. Training in tropical medicine will be mostly for service in public health and governmental medical care. Nevertheless, our own government will doubtless share in an international responsibility to maintain and improve health in certain tropical and subtropical areas after the war and will need medical personnel trained in tropical medicine and its many specialties ranging from parasitology to nutrition. In any event a greater knowledge of tropical medicine by the medical profession of the United States is an urgent need.

This report has been reviewed, corrected and adopted by the committee, and is respectfully submitted to the council of the academy.

WILBUR A. SAWYER, *Chairman*
ERNEST CARROLL FAUST, *Secretary*

Approved by the council of the academy and submitted to the American Foundation for Tropical Medicine, February 4, 1944.

SPECIAL ARTICLES

AZIDE INHIBITION OF ANAEROBIC ASSIMILATION OF GLUCOSE BY YEAST AND ITS APPLICATION TO THE DETERMINATION OF FERMENTABLE SUGAR

In the determination of fermentable sugar by yeast fermentation methods, the amount of carbon dioxide produced is usually 10 to 35 per cent. lower than that expected from the familiar equation for alcoholic fermentation. The low recoveries appear to be due to the assimilation of a portion of the sugar to form intracellular carbohydrate, since anaerobic assimilation of appreciable amounts of glucose by yeast has been observed even in very short term experiments.[1, 2]

Sodium azide and other respiratory poisons have been observed to inhibit the anaerobic uptake of ammonia[3] and the aerobic assimilation of several oxidizable substrates[4, 5, 6] by yeast. This suggested that the anaerobic assimilation of fermentable sugars could also be stopped by using these inhibitors, thus allowing conversion of all the fermentable sugar to carbon dioxide and alcohol. This possibility was tested by measuring manometrically the total carbon dioxide produced from the anaerobic fermentation of known amounts of glucose by washed bakers' yeast in the presence or absence of 10^{-3} M sodium azide. Table 1 shows typical results. The total carbon dioxide production corresponded to 67 per cent. of the added glucose in the absence of inhibitor, and 100 per cent. in the presence of 10^{-3} M sodium azide. The rate of fermentation was not altered by this concentration of azide. Table 1 also shows a similar increase in the carbon dioxide produced from the fermentable sugar in rat serum and in tungstic acid filtrates of this serum by yeast when azide was present. Known amounts of glucose were completely fermented in rat serum in the presence but not in the absence of azide.

TABLE 1

EFFECT OF 10^{-3} M SODIUM AZIDE ON RECOVERY OF GLUCOSE (TEMPERATURE 30° C., pH 4.5, 0.05 M SUCCINATE, 25 MG WASHED BAKERS' YEAST IN NITROGEN GAS)

Azide	Glucose	Rat serum	Tungstic acid filtrate of rat serum (1:10)	Total CO_2 produced	Glucose equivalent to CO_2	Per cent. recovery
m	*mg*	*cc*	*cc*	*mm*³	*mg*	
0	0	0	0	7.0	0.028	..
0	1.0	0	0	166	0.67	67
10^{-3}	1.0	0	0	251	1.01	101
0	2.0	0	0	336	1.35	67
10^{-3}	2.0	0	0	505	2.04	102
0	0	.3	0	87	0.35	..
10^{-3}	0	.3	0	128	0.52	..
10^{-3}	1.0	.3	0	382	1.54	102
0	0	0	1.5	44	0.18	..
10^{-3}	0	0	1.5	64.0	0.26	..
10^{-3}	1.0	0	1.5	320	1.29	103

If young (24-hour) pure cultures of yeast (*Saccharomyces cerevisiae* isolated from commercial bakers' yeast) were used immediately upon removal from slants and washing by centrifugation, glucose recoveries were only 5 to 10 per cent. lower than theoretical. If however, the yeast was aerated 2 to 10 hours after washing, the recoveries were increasingly low, reaching a minimum of about 33 per cent. lower than theoretical. This value of 67 per cent. recovery was obtained repeatedly in aerated yeast, and suggests that under optimum conditions for assimilation, one third of the glucose is synthesized into cell material (presumably glycogen), the rest being fermented. Similar results have been obtained in the aerobic metabolism of glucose and other substrates.[4, 5, 6, 7]

The fact that anaerobic assimilation of glucose and ammonia can be completely inhibited by cellular poisons usually considered to be inhibitors of heavy metal enzymes might suggest that iron-containing enzymes are involved in the assimilation of both carbon and nitrogen by yeast. However, a selective inhibition of aerobic assimilation has been described for a number of other toxic substances including iodoacetate and dinitrophenol, and the azide inhibition of anaerobic assimilation should not yet be considered good evidence that heavy metal catalysts are involved in the assimilation reactions.

These results indicate that an improvement in the manometric or titrometric determination of fermentable carbohydrate may be achieved by carrying out the yeast fermentation in the presence of sodium azide. We have found it satisfactory to place the sample containing 0.2 to 2 mg of glucose equivalent buffered at pH 4.5 with 0.05 M succinate and 10^{-3} M in sodium azide in the main compartment of Warburg vessels. About 25 mg of washed bakers' yeast is added from the side arms after temperature equilibration and removal of oxygen with nitrogen. The production of carbon dioxide is followed until it virtually ceases (in 10 to 40 minutes), and the amount of fermentable car-

[1] C. B. van Niel and E. H. Anderson, *Jour. Cell. and Comp. Physiol.*, 17: 49, 1941.

[2] R. J. Winzler and J. P. Baumberger, *Jour. Cell. and Comp. Physiol.*, 12: 183, 1938.

[3] R. J. Winzler, Dean Burk and V. du Vigneaud (in press).

[4] C. E. Clifton, *Enzymologia*, 4: 246, 1937.

[5] R. J. Winzler, *Jour. Cell. and Comp. Physiol.*, 15: 343–354, 1940.

[6] M. J. Pickett and C. E. Clifton, *Jour. Cell. and Comp. Physiol.*, 22: 147, 1943.

[7] C. B. van Niel and A. L. Cohen, *Jour. Cell. and Comp. Physiol.*, 20: 95, 1942.

bohydrate is then calculated as glucose from the following relation:

$$\text{mg. of glucose in sample} = \frac{\text{mm}^3\ CO_2\ \text{produced}}{248\ \text{mm}^3}$$

No determination of a correction factor from standard glucose solutions is necessary.

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CONVERSION OF GLOBULAR TO ORIENTED FIBROUS PROTEINS

It was reported recently[1] that several globular proteins can be changed into a fibrous form by heating them in the presence of water and subjecting them to high shear stress. As evidenced by x-ray diffraction, the converted protein molecules have substantially the same spatial arrangement as the molecules of the natural fibrous protein, β-keratin, as it occurs in feathers and stretched wool and hair. To the list of globular proteins that can thus be made fibrous in the molecular sense may now be added gliadin, the mixed proteins of blood serum[2] and the globulins of tobacco and pumpkin seed.[2]

Conversion from the globular to the fibrous form has also been effected by soaking protein filaments in aqueous solutions of various reagents, followed by stretching, both treatments being carried out at room temperature.[3,4] Ovalbumin, lactoglobulin, casein and pumpkin seed globulin have been converted from the globular to the oriented fibrous form in this way. Ovalbumin has been particularly easy to unfold and orient. β-keratin diffraction patterns have been given by ovalbumin filaments stretched at room temperature after being treated with such aqueous solutions as the following: 75 per cent. methanol, 75 per cent. ethanol, 75 per cent. isopropanol, 50 per cent. t-butanol, saturated benzyl alcohol, 5 per cent. phenol, 75 per cent. formamide, 50 per cent. urethane, 50 per cent. pyridine, saturated aniline, 75 per cent. acetaldehyde, 90 per cent. acetone, saturated methyl ethyl ketone, 50 per cent. ethylene glycol monoethyl ether, 75 per cent. dioxane, 10 per cent. chloral hydrate, 10 per cent. silver nitrate, saturated cerous nitrate, 50 per cent. cupric nitrate, 10 per cent. trichloroacetic acid, 25 per cent. sulfuric acid, 20 per cent. hydrochloric acid, 17 per cent. nitric acid, 10 per cent. toluene sulfonic acid and 5 per cent. sodium hydroxide. Ovalbumin filaments soaked in acetic anhydride, glacial acetic acid, 98–100 per cent. formic acid, 65 per cent. lithium bromide, 50 per cent. ammonium thiocyanate, or saturated aqueous solutions of either urea or guanidine hydrochloride, and then in water were stretched to give the β-keratin structure.

It should be mentioned that the "egg-white" pattern of Astbury, Dickinson and Bailey,[3] characterized by the 9.8 Å reflection on the equator and the 4.7 Å reflection on the meridian, has been obtained also from chemically treated ovalbumin.[1]

The concentration of the reagent is not critical, and the time of soaking required to render the filaments stretchable ranges from a few minutes to several hours. For example, filaments soaked in saturated ammonium thiocyanate for two minutes and then in water for three minutes were stretched to a draw ratio (ratio of final to initial length) of 4.9 and gave the β-keratin pattern. Soaking in saturated aniline did not produce good stretching characteristics until after about five hours. Roughly, a draw ratio of five is required to give good orientation. If internal friction is small, the high shear required for orientation is not developed on stretching, and despite a large draw ratio the specimen gives only an amorphous diffraction pattern. Conversely, if cohesion and internal friction are large, a draw ratio of only two or three will give good fiber patterns. Ordinarily, filaments are most easily stretched while moist, but certain ovalbumin preparations, particularly those treated with phenol solution, may be stretched readily when air-dry. The phenol-treated ovalbumin filaments were also remarkable in that they exhibited the typical characteristics[5] of cold drawing, that is, on application of tensile stress they "necked down" and with continued stretching the necked-down, oriented section grew at the expense of the larger, unoriented sections.

Chemical treatment increases the degree of ordering of the peptide chains. Strong diffraction rings at approximately 4.7 and 9.8 Å sharpen, and fainter rings are resolved from diffuse halos.[6] As many as five diffraction rings have been obtained from ovalbumin treated with aqueous methanol, formamide or urethane. The rings from the formamide-treated ovalbumin occurred at 10.7, 4.7, 3.7, 2.2 and 2.0 Å. As a rule, preparations showing the largest number of diffraction rings and the sharpest rings were most easily oriented and gave fiber patterns containing the greatest

[1] F. R. Senti, C. R. Eddy and G. C. Nutting, *Jour. Am. Chem. Soc.*, 65: 2473, 1943.

[2] We should like to thank Sharp and Dohme, Inc., for the serum proteins, and H. B. Vickery, of the Connecticut Agricultural Experiment Station, for the pumpkin seed globulin.

[3] W. T. Astbury, S. Dickinson and K. Bailey, *Biochem. Jour.*, 29: 2351, 1935.

[4] K. J. Palmer and J. A. Galvin, *Jour. Am. Chem. Soc.*, 65: 2187, 1943.

[5] W. H. Carothers and J. W. Hill, *Jour. Am. Chem. Soc.*, 54: 1579, 1932.

[6] G. L. Clark and J. H. Shenk, *Radiology*, 28: 58, 144, 1937, observed sharpening of the 4.7 and 9.8 Å diffraction rings of ovalbumin and hemoglobin precipitated from dilute solution by trichloroacetic acid, ethanol, acetone or formalin. M. Spiegel-Adolph and G. C. Henny, *Jour. Phys. Chem.*, 46: 58, 1942, observed sharpening of the pattern of pseudoglobulin denatured by ethanol.

detail. The nine forms found in the fiber pattern of β-keratin and heated ovalbumin[1] have been found also in chemically treated ovalbumin. The chemicals used were by no means equally effective in converting the globular protein to the fibrous form. However, the degree of crystallinity and orientation produced by treatment with aqueous formamide, urethane or aliphatic alcohols was at least equal to that obtained after heat treatment. Judging from the sharpness and length of the diffraction arcs, the best of the converted protein preparations were equal to the natural fiber, raw silk, in both crystallinity and orientation.

Filaments of the more soluble proteins were prepared by mixing the powdered material with approximately half its weight of water and extruding the mixture through a die in an arbor press. One per cent. of sodium chloride was added to the mixture of pumpkin seed globulin and water to make it readily extrudable. Casein filaments were extruded from a briefly heated casein-water mixture. This heating produced no detectable change in the x-ray diffraction pattern.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A CLOSED CIRCUIT APPARATUS FOR THE MEASUREMENT OF RESPIRATORY METABOLISM

Several devices for calorimetry of small animals have been described.[1, 2, 3, 4] Metabolic studies frequently require the determination of the exchange of respiratory gases for large numbers of animals. Because of certain disadvantages in some of these methods we have devised an apparatus shown in Figs. 1 and 2.

The chamber is constructed of heavy brass tubing, 4 inches (10 cm) in diameter and 9 inches (23 cm) in length. A screw cap is fitted to one end and a smaller brass tube 3 inches (7.6 cm) long and 3¼ inches (8.3 cm) in diameter is riveted to the other end and closed by a screw cap. The smaller tube contains a 6-volt electric motor and fan assembly from an automotive windshield defrosting unit. This centrifugal fan circulates the gases through a 1-inch (2.5 cm) glass tube which is filled with soda lime and attached by rubber connections to the bottom of the main chamber.

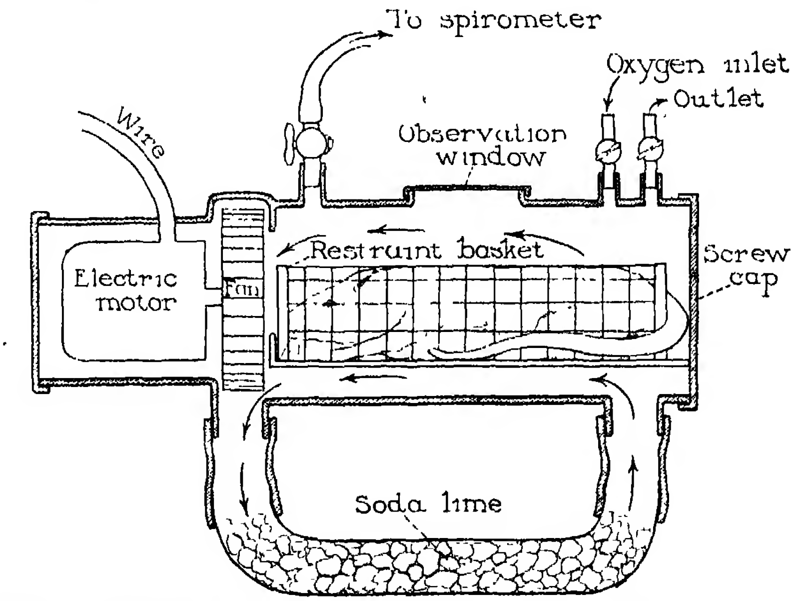

Fig. 1. Cross section of metabolic chamber showing rat in place in restraint basket.

Three outlets equipped with stopcocks lead from the upper part of the chamber; one is for the inflow of oxygen, one is a simple outlet or vent and the third one connects the respiratory chamber with a small, brass, Krogh spirometer measuring 5½ by 3 by 2½

[1] F. G. Benedict and Grace MacLeod, *Jour. Nutrition*, 1: 343–366, 1929.
[2] M. L. Tainter and D. A. Rytand, *Proc. Soc. Exper. Biol. and Med.*, 32: 361–363, 1934.
[3] E. L. Schwabe and F. R. Griffith, Jr., *Jour. Nutrition*, 15: 187–198, 1938.
[4] W. H. Newton, *Jour. Physiol.*, 89: 421–428, 1937.

[7] One of four Regional Research Laboratories operated by the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, U. S. Department of Agriculture.

inches (14 by 7.6 by 5.7 cm). Kerosene was found to be a satisfactory fluid for use in the spirometer. A concave mirror is attached to the axis of the spirometer float, so that any change of volume within the respiratory chamber causes a rotation of the mirror. The image from a single filament bulb is focused by the concave mirror on an arc equipped with a centimeter scale, the radius of which is such that an excursion of the light beam of 1 cm on the scale equals a change of volume of 1 cc within the respiratory chamber.

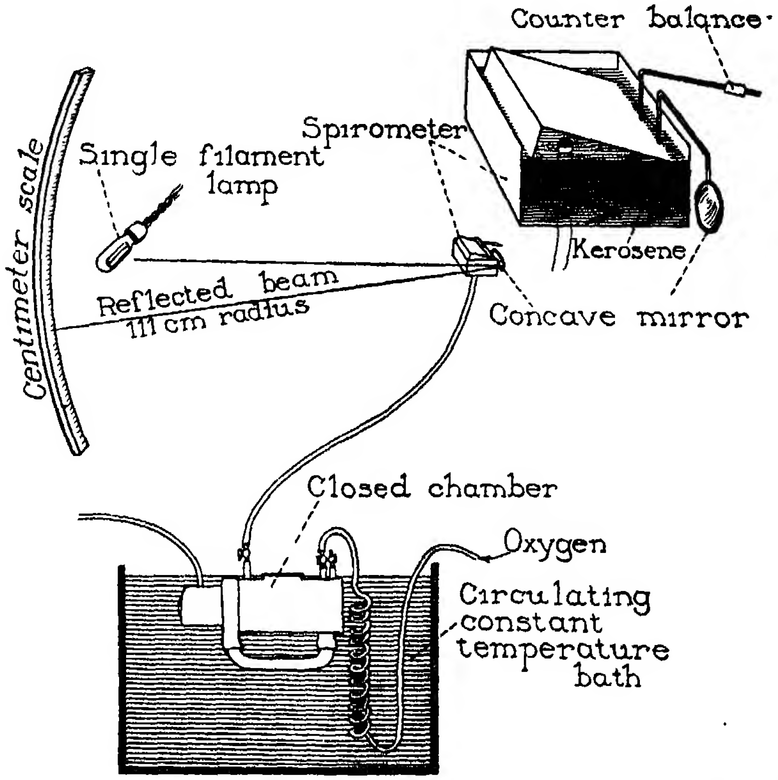

Fig. 2. Arrangement of metabolic chamber, spirometer and scale. Note that oxygen intake passes through a coil submerged in the constant temperature bath.

Half an hour before the first metabolic determination is made the unit is submerged, with the motor running, in a constant temperature bath thermostatically regulated to ± 0.10° C. In rat calorimetry the temperature was maintained at 28° C, as suggested by Benedict and MacLeod. Small restraint baskets of wire mesh were designed to limit the activity of the animal before and during a calorimetric determination.

After the rat (enclosed in a basket) has been placed in the chamber and submerged, oxygen is passed slowly into the system for five to seven minutes. One starts the experiment by closing the oxygen supply and the outlet stopcock and opening the stopcock to the spirometer. The deviation of the beam of light during five minutes indicates the volume of oxygen consumed in that period. Three to five consecutive readings are obtained. Water vapor pressure is maintained constant by the presence of a moist sponge in the chamber.

The performance of this apparatus is entirely satisfactory in our hands. Any limitations of the method are in the experimental animal and not in the apparatus. The unit is inexpensive to build and could be made easily in the average machine shop.

Asher Chapman
Edward J. Baldes
George M. Higgins

Mayo Foundation

BOOKS RECEIVED

Bridges, Calvin B. and Katherine S. Brehme. *The Mutants of Drosophila Melanogaster.* Illustrated. Pp. vii + 257. Carnegie Institution of Washington. $2.50, paper cover; $3.00, cloth cover.

Pender, Harold and S. Reid Warren, Jr. *Electric Circuits and Fields.* Illustrated. Pp. xv + 534. McGraw-Hill Book Co. $4.00.

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Seward, Albert. *Geology for Everyman.* Illustrated. Pp. xi + 312. Cambridge University Press. $3.25.

Thompson, Warren S. *Plenty of People.* Illustrated. Pp. x + 246. Jaques Cattell Press. [illegible]

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NEW HYBRIDS FROM INCOMPATIBLE CROSSES IN DATURA THROUGH CULTURE OF EXCISED EMBRYOS ON MALT MEDIA[1]

By ALBERT F. BLAKESLEE and SOPHIE SATINA
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INCREASINGLY of recent years it is becoming possible to control the activities of the living plant by chemical treatment. The success in doubling chromosomal numbers with colchicine and other stimuli naturally led to an attempt to halve the chromosomal number by some similarly simple treatment. The fact that over two hundred haploids ($1n$) had turned up spontaneously in our cultures of Daturas since 1921 showed that the plant is capable of producing individuals with half the normal $2n$ chromosomal complement. Preliminary attempts to induce the production of $1n$ offspring by treating the unfertilized egg cells with a wide series of stimuli were entirely unsuccessful. In the summer of 1940 the cooperation of Drs. J. van Overbeek and Marie Conklin was secured in a more intensive attack on the problem. Something was learned about the processes involved in embryo development,[2] but none of the stimuli tested induced the production of $1n$ embryos. In the summer of 1941 they attacked the problem from a different standpoint in order to learn more about the factors involved in embryo development and attempted to dig out the young embryos and cultivate them on artificial media. The older embryos could be thus readily cultivated, but the smaller ones (under 0.5 mm in *D.*

[1] Read before the American Philosophical Society November 19, 1943 Contributions from the Department of Botany, Smith College, New Series, No 12 This investigation was supported in part by the Carnegie Institution of Washington and by a grant from the American Philosophical Society The authors are indebted to Margaret Conlin, Jean Cummings, Susanne McLean and Mary Sanders, who as graduate assistants have made a large proportion of the dissections

[2] J. van Overbeek, M. E. Conklin and A. F. Blakeslee, *Am. Jour. Bot.*, 28: 647–656, 1941.

stramonium) would not grow on the artificial media. Since in some cases the spontaneous ($1n$) haploids which appeared in our cultures had been shown to be twins developed within the same seed envelopes as the normal ($2n$) diploids, it was suggested that in such cases some substance in the normal twin might have stimulated the development of the $1n$ partner and that it might be possible to extract this substance and use it in the artificial media. Dr. van Overbeek suggested rather the use of coconut milk, which is a natural endosperm. With this it was possible to culture stramonium embryos as small as 0.2 and 0.15 mm in diameter.[3] Later with the cooperation of Dr. Haagen-Smit the "embryo factor" in coconut milk was concentrated and freed from a number of contaminating substances which deleteriously affected embryo growth.[4]

In reporting this work[5] it was suggested that such growth of excised embryos on artificial media might ensure the success of many wide crosses hitherto impossible. We now have evidence that this suggestion was well founded and we are utilizing the technique just described in a study of speciation within the genus Datura. To analyze chromosomal changes in evolution of the 10 herbaceous species of this genus, hybrids are necessary in which chromosomes may be matched up and compared. Unfortunately, hybrids between certain species have not heretofore been possible. Some of the blocks to crossability may be mentioned:

(1) Racial differences, presumably due to genes, may prevent hybridization. Thus, the first race of *D. leichhardtii* from Australia crosses readily with *D. discolor* as the pollen parent, but the second race of *D. leichhardtii* from the same country, which is indistinguishable in appearance from the first, gives only arrested embryos when similarly pollinated.

(2) The pollen applied to the stigma of the female parent may fail to germinate. This is not true, however, of pollinations between any of the ten herbaceous species of Datura. Lack of pollen germination does not seem to be an important block to crossability. Pollen of other genera of the Solanaceae, such as Petunia and Nicotiana, for example, have been found to germinate on stigma of *D. stramonium* and to ensure the setting of small but sterile capsules.

(3) The pollen tubes may burst before reaching the ovary and thus the opportunity for fertilization prevented as has been shown by an earlier study of Buchholz[6] *et al.*

(4) The slower growth of pollen tubes of short-flowered species may be a handicap to them in reaching the ovaries of long-flowered Daturas before the styles become withered. Perhaps such crosses could be facilitated by splicing of styles which Buchholz and Doak[7] employed to increase pollen transmission of extra chromosomes in *D. stramonium*.

(5) Fertilization may fail to take place after the pollen tubes reach the ovary. Whether this condition occurs in species crosses in Datura is not known, but not all the incompatible species crosses in the genus have been studied from this standpoint.

(6) Fertilization may occur, but the zygotes abort at an early stage. Thus, in the cross *D. stramonium* × *D. metel*[8] there are abundant fertilizations, but the fertilized egg cell develops to not more than 8 cells before the proembryos become aborted.

(7) Fertilization may take place and embryos develop to a later stage when something arrests their further growth and the imperfect seeds which result are incapable of germination. Of arrested embryos there are two main classes: those represented by the cross *D. inoxia* × *D. discolor* in which a large proportion of the embryos reach a relatively advanced stage before becoming arrested and those represented by the cross *D. inoxia* × *D. stramonium* in which only an occasional embryo in a capsule reaches such an advanced stage.

It is possible to dissect out the hybrid embryos which become arrested after the proembryo stage and to cultivate them on artificial media with the technique developed by van Overbeek and Conklin for normal embryos of *D. stramonium*. The media used contained the necessary salts, vitamins and the "embryo factor" secured from coconut milk. When embryos are small (diameter under 0.5 mm), only slight if any growth occurs without the "embryo factor." We have recently found that powdered malt extract can replace the "embryo factor" from coconut milk if sterilized by filtration instead of by heat.

With the malt media we have gotten growth of hybrid embryos from 11 new species combinations in Datura. By similar embryo culture we have secured species hybrids from combinations which had given only a single viable seed from many hundred pollinations. In addition, the dissection method has enabled us to secure numerous seedlings of certain species the seeds of which without treatment give a germination of only about 0.1 per cent. One aberrant species (*D. ceratocaula*), which is semiaquatic and

[3] J. van Overbeek, M. E. Conklin and A. F. Blakeslee, SCIENCE, 94: 350–351, 1941; *Am. Jour. Bot.*, 29: 472–477, 1942.

[4] J. van Overbeek, *Cold Spring Harbor Symp. Quar. Biol.*, 10: 126–133, 1942.

[5] A. F. Blakeslee, *et al.*, *Carnegie Institution of Washington Year Book*, 40: 214–225, 1941.

[6] J. T. Buchholz, L. F. Williams and A. F. Blakeslee, *Proc. Nat. Acad. Sci.*, 21: 651–656, 1935.

[7] J. T. Buchholz, C. C. Doak and A. F. Blakeslee, *Bull. Torrey Bot. Club*, 59: 109–118, 1932.

[8] Sophia Satina and A. F. Blakeslee, *Bull. Torrey Bot. Club*, 62: 301–312, 1935.

grows in shallow ponds in Mexico, had never hybridized with any Datura. Through use of malt media, however, it has given hybrids with several species among which is *D. stramonium.* In this latter species there have been developed a large series of chromosomal tester races (Prime types) with which the chromosomes in *D. ceratocaula* may be determined. Perhaps our most surprising success of the dissection method is securing hybrids between *D. inoxia* and a tree Datura. This suggests the possibility of extending chromosomal analysis to the group of tree Daturas which by some taxonomists are considered generically distinct from the herbaceous Daturas and to be included in a separate genus, *Brugmansia.*

The excised embryos may be extremely slow in developing in the culture media and for some time after surviving the shock of transplanting into soil, which is often a disastrous experience. Ultimately, however, the hybrids which survive have developed into vigorous plants without sign of weakness.

We have apparently succeeded in getting a new hybrid of Iris (*I. pseudacorus* × *I. versicolor*) from dissection of arrested embryos sent us by Dr. George M. Reed, of the Brooklyn Botanic Garden. We have evidence that the technique described may be of value also in other genera in securing new hybrids which have hitherto been impossible. Moreover, Skirm[9] has recently succeeded in getting a number of new hybrids from the dissection of hybrid embryos of different species of Lilium which appear not to need the aid of the "embryo factor" from coconut milk or malt extract for their development in artificial media.

Systematic study of other genera would be necessary before one would be warranted in taking the genus Datura as typical of the proportion of new hybrids which can be secured in other groups by cultivation of excised embryos. Our experience with Daturas, though incomplete, would suggest alluring possibilities with other forms. With the 10 herbaceous species of Datura there are 90 hybrid combinations theoretically possible if each species is considered separately as male and female parent. The formula is $n\ (n-1)$. Viable hybrid seed was secured in 18 combinations, a number which might possibly be slightly raised if a large number of pollinations had been made in some of the combinations. In 49 combinations no attempt has yet been made to dissect out arrested embryos or the capsules from recent pollinations have not yet reached a dissectable stage. In 12 combinations dissections have been attempted but without success. In 11 combinations, arrested embryos have been dissected and cultured. Of the 23 combinations actually tested 11, or 48 per cent., have given dissectable embryos which have been brought into cultivation. In attempting to get hybrids from arrested embryos, we have begun with those combinations which would be of most value to our study of chromosomal differences between species, but there is no reason to believe that when the combinations which have failed to yield viable seeds are completely analyzed, the percentage of arrested embryos which can be cultivated will be greatly altered. If we should succeed in our attempts to coax development of the early-aborting embryos, such as those found from the cross *D. stramonium* × *D. metel,* we might be able to secure nearly all the hybrids theoretically possible from the 90 species combinations among our 10 herbaceous Daturas.

The dissection technique may aid in an understanding of the factors involved in chemical regulation of embryo development and new hybrids which it seems capable of supplying may prove useful in genetical analysis of other forms than Datura. They give promise, moreover, of becoming of considerable value economically. Hybrids, especially from wide crosses, are characterized by increased vigor as exampled by the high yields of hybrid corn. Although intermediate forms are common, hybrids may be classified into fertile hybrids and sterile hybrids. The latter are sometimes called "mule plants" since they are like the sturdy mule in that they can not form sex cells since the chromosomes of one parent are too unlike those of the other parents to mate and form pairs; and pairing of chromosomes is necessary for sexual reproduction. Such sterile hybrids may be rendered fertile and pure-breeding with retention of hybrid vigor by doubling chromosome number.[10] In a number of cases sterile hybrids between species have been made fertile through spontaneous doubling of chromosome number which had taken place before recorded history to produce pure-breeding races which had been preserved by prehistoric man because of their superior qualities. Among such fertile "mule plants" may be mentioned our best varieties of wheat, oats, timothy, tobacco and cotton. We no longer have to wait ages for the chance hybridization between species and the later rare spontaneous doubling of their chromosomes in order to secure such superior varieties. With the use of colchicine we can now make them up to order, provided we have the sterile hybrids to start with. The dissection technique should considerably increase the source of these sterile hybrids. These two methods in combination bid fair to be of considerable service in increasing the yield of plant products in a time when need is felt for ways of growing two blades of grass with the labor formerly required to grow one.

9 C. W. Skirm, *Jour. Hered.*, 33: 211–215, 1942.

10 A. F. Blakeslee, *Amer. Jour. Bot.*, 26: 163–172, 1939.

In this relatively new field there is opportunity and need for many investigators to explore the range within which artificial cultivation of hybrid embryos is feasible, to improve the technique of such cultivation and to adapt it to the different forms investigated and to study the factors which limit crossability with the aim of still further increasing the possibilities of hybridization.

It should be stated that others have also cultivated hybrid embryos on artificial media Our contribution to the hybridization problem lies in the use of the "embryo factor" and the application of the technique of van Overbeek and Conklin which enable embryos to be excised and cultivated at an earlier stage, at least in Datura, than has heretofore been possible, and in the use of malt extract as a more convenient source of the "embryo factor" than coconut milk.

Further study of regulatory factors involved in fertilization and embryo differentiation should lead to a conscious control of a wider range of life processes.

USING ELECTRONS FOR MICROANALYSIS

By Dr. V. K. ZWORYKIN
RADIO CORPORATION OF AMERICA, PRINCETON, N. J.

THE past decade has seen an exceedingly rapid growth of the development and use of electronic tools in all sciences. One of the most spectacular of these is the electron microscope which, with its extremely high resolving power, is able to project man's vision further than was ever before possible towards the direct observation of the building blocks of nature. While our vision has been greatly extended and now enables us to see things in the size range 20 to $10{,}000 \times 10^{-7}$ millimeters, the type of information that we obtain through the sense of vision has not changed in any way; that is, we see the size, shape and structure of the finer details of a specimen but nothing else Such information is sufficient for the solution of innumerable research problems but it does not represent in any way a complete exploitation of the electron microscope or of the electron optical method. If we are to make full use of what we observe with the electron microscope we must supplement it by the proper application of controlled experiments or by the development of new tools which provide additional information in this same size range.

One of the most specific types of information that would be of immediate use in the field of electron microscopy is that pertaining to the nature or composition of the entities observed. In a large part of the work being carried on with the electron microscope pure samples are used so that the information with regard to shape, size and structure can be tied up immediately with the chemical and physical properties of the material. However, when the electron microscope is applied to problems in which complex or organized structures are present, the different entities observed are spread out in the image and there is no direct way of correlating the composition of a specific particle with a chemical analysis made on the specimen in bulk. A number of methods of attacking this problem have already been suggested and some preliminary work has been done.

One method is the correlation of the intensities of image points with the mass densities of corresponding object points. While the theory of the electron microscope shows that there is a relationship between the mass density of the object and the intensity of the image, it is difficult to obtain an accurate measure of density in this way because of the necessity of knowing accurately the thickness of any given object point. Another discouraging feature of this method is that more often than not intensity anomalies occur in the image as a result of electron interferences which take place if the particles being investigated are crystalline.

Electron diffraction has always been a very useful method of analysis—particularly of powdered chemicals. Unfortunately, like most other methods, it gives an analysis of the whole specimen. Recently, there have been attempts to apply electron diffraction to point analysis. In these methods the irradiating beam is confined to the small areas of the specimen under investigation. While this method shows some promise, it can be applied only in the case of crystalline particles and even in this its usefulness is limited by the fact that the individual particles are almost invariably single crystals. This requires that they have the proper orientation in the specimen before a pattern can be obtained and the pattern produced is that of a single crystal which in itself is not always sufficient for the identification of a compound The third method which may be applied for identifying the chemical nature of particles is the use of specific reagents which change the mass density of the particles in question. While this method appears to be tedious and not too certain of success in any particular case, some exploratory work in connection with the selective staining of bacteria has been done.

Recently, in a paper to the *Physical Review,* J. Hillier of this laboratory has described a more direct electronic method of attacking the problems outlined above. The paper described a new type of instrument which is named the electron microanalyzer and in

which a fundamentally different method of obtaining a chemical analysis is used.

Throughout the development of the electron microscope it has been realized that the electrons, on passing through the specimen, often lose small amounts of energy due to inelastic collisions with the atomic electrons of the specimen. X-ray theory predicts that if in an inelastic collision one of the electrons from an inner shell of an atom of the specimen is removed, the colliding electron must lose an amount of energy equal to or greater than that found in the subsequently emitted x-ray photon. While this was realized sometime ago, it was only recently that the phenomenon was observed experimentally. Since for each type of atom it takes a discrete and different amount of energy to remove one of the inner electrons, it appears that this phenomena can be used to identify the atoms in a specimen

The experimental method of doing this is quite straightforward. The specimen is bombarded by a beam of electrons of one velocity and the velocity distribution in the transmitted electrons measured by a suitable means. The position of the peaks on the resulting velocity distribution curve is sufficient to identify the elements present in the specimen. However, in itself, this is not satisfactory for direct application to the problem of identifying individual particles on electron microscope specimens because it gives no information regarding the location of the particles. It is the ability to identify both the elemental composition and the location of an area in a specimen that characterizes the electron microanalyzer

In the electron microanalyzer electron lenses are used to confine the electron beam to only that area of the specimen which is to be analyzed. Moreover, the area being analyzed and the specimen as a whole can be observed by means of an electron microscope which is incorporated in the instrument Since both modes of operation of the instrument use the same lens system, the instrument is extremely compact.

As a result of the use of the "probe" method and a high quality electron optical system, it has been possible to greatly enhance the resolving power of the conventional electron velocity analyzer. In fact, in this new instrument, practical limitations on the resolving power are almost completely removed. In the present experimental model the velocity of the transmitted electrons can already be measured to one part in 5,000. Moreover, this resolving power can be increased or decreased at will; the only limitation being in the degree of homogeneity of the incident beam.

At the present time the instrument is being carefully tested using thin films of known materials in order that its possibilities and limitations may be better understood. The velocity distributions which are characteristic of a number of elements have been obtained proving that all the elements up to atomic number 26 can be detected with the present experimental model of the instrument There seems to be no theoretical reason why this list can not be extended throughout the periodic table.

It is apparent that the major limitation of the instrument at the present time is its inability to differentiate between organic compounds, though there are indications that quantitative measurements on the heights of the peaks in the velocity distribution curve will yield some information in this regard As in all radically new types of instruments, it is extremely difficult to predict the future uses and applications. It is evident that the microanalyzer is worthy of further investigation Already the high resolving power which is obtained in this method of velocity analysis points to the possibility of applying it to obtain direct information with regard to collision problems in quantum physics Added to this is the attractive possibility of obtaining direct elemental analysis of supermicroscopic structures, particularly in biological problems where the location of elements other than carbon, nitrogen and oxygen in the specimen is important

OBITUARY

WILLIAM EMERSON RITTER: NATURALIST AND PHILOSOPHER[1]

PROFESSOR RITTER had entered his eighty-eighth year at the time of his death a few months ago (January 10). His advanced age must have come as a surprise to many, for as recently as 1938 he had brought out an impressive volume of biological fact and interpretation, and he had contributed to some of our scientific journals even later than that. Ritter got a somewhat delayed start in his scientific career, but he more than compensated for this by exceptional productivity at an age when most of us lapse into silence.

William Emerson Ritter was born in Hampden, Wisconsin, on November 19, 1856. Much of his boyhood was spent on a farm, and to this period of his life he was fond of referring later. It was here, no doubt, that his life-long love of nature commenced. He graduated from the State Normal School at Oshkosh in 1884, and engaged in public school teaching in his native state before carrying his education to higher levels. In 1888 he received his B.S. from the University of California, and his doctorate was attained at

[1] Contributions of the Scripps Institution of Oceanography, New Series No. 223.

Harvard in 1893, when he was 36 years old. In June, 1891, he married Dr. Mary E. Bennett, whom he characterizes in a dedication as "my severest critic and best helper." There is no doubt of the important part which she played in various phases of his career. Ritter's quest of knowledge and adventure took him to Naples and Berlin in 1894–95; later to England, Japan and various points in the Pacific area He was a member of the carefully selected party of naturalists which comprised the Harriman Alaska Expedition of 1899 His academic positions ranged from that of instructor in biology at the University of California to the headship of the department of zoology, in the same university, a position which he held until he assumed directorship of the Scripps Institution of Biological Research in 1909. He retained a professorship in the department, however, until he was retired as "professor emeritus" in 1923. Ten years later the degree of LL.D. was bestowed both upon Professor Ritter and upon Dr. Mary Bennett Ritter, his wife.

Ritter's first published paper of which I find record dealt with "The parietal eye of some lizards from the western United States,"[2] thus appearing in his thirty-fifth year Two years later came his doctor's thesis, "On the Eyes, the Integumentary Sense Papillae, and the Integument of the San Diego Blind Fish (*Typhlogobius californiensis Steindachner*)"[3]

Up to nearly 1910, Ritter's biological contributions lay predominantly in the fields of taxonomy and morphology, his special groups being the tunicata and enteropneusta. The texts and figures of these papers (the figures mainly of his own execution, it would seem) bear witness to a high degree of care and thoroughness in his observation and delineation. But questions of interpretation frequently occupied his attention, as is evidenced, for example, by such a title as "*Halocynthia johnsoni* n. sp., a Comprehensive Inquiry as to the Extent of Law and Order that Prevails in a Single Animal Species."[4]

These morphological and taxonomic studies gave place rather early to behavioristic and philosophical ones, and it is probably these last by which Ritter is more largely known. His stature as a biological philosopher can probably be fairly measured only by another philosopher. His writings reveal extensive acquaintance both with the literature of philosophy and of the history of science, such an acquaintance as I believe few living zoologists possess. And they reveal preoccupation with certain philosophical problems throughout much of his life. His association with Howison at the University of California appears to have been partly responsible for this trend, though the viewpoints of the two men differed very widely. Ritter was primarily a naturalist, Howison a subjective idealist.

Ritter's outstanding published work in the field of biological philosophy bears the title "The Unity of the Organism, or the Organismal Conception of Life."[5] This two-volume book has as its "central idea" that "The organism in its totality is as essential to an explanation of its elements as its elements are to an explanation of the organism." The contrary viewpoint he characterizes as the "elementalist" one, and this viewpoint he seems to attribute, in varying measure, to all other living biologists.

The metaphysical implications of Ritter's "central idea" are matters which the present writer is quite unqualified to discuss That his position is a "vitalistic" one Ritter denies emphatically, and his denial carries conviction. Superficially, at least, there seems to be much in common between his views and ones set forth during several past decades under such names as "emergent evolution," "creative evolution," "creative synthesis" and "holism." He insists upon an all-out physico-chemical basis for vital phenomena, but he equally insists upon the appearance of entirely new attributes only potentially present in the chemical elements.

Ritter challenges the mechanistic physiologist to state just what he means by expressing a vital phenomenon (say a dog's scratching reflex) in "terms" of the physico-chemical elements involved. This "can be done in one and only one way, namely, by adding to the attributes, that is to the 'terms' which inorganic chemistry recognizes in the chemical agents concerned, just those attributes and terms which the dog's scratch reflex requires in order that the elements may explain the reflex." For brevity's sake, he coins the whimsical abbreviation "doscarex" for the reflex in question, and proceeds to discuss the "doscarecious powers of the oxygen, carbon and so forth," so unforeseeable by the mere chemist![6] This is rare humor. Is it not possibly sound philosophy?

In view of these forthright assertions regarding the relations of the organic to the inorganic, it is rather surprising to find Ritter aligning himself with those few biologists who seriously question the ultimate derivation of the former from the latter, and take refuge in such conceptions as the "panspermia" hypothesis of Arrhenius and others. He could scarcely have questioned the force of such contrary arguments as have recently been set forth by Oparin,[7] who removes one of the difficulties in the way of accepting the earlier

[2] *Bull. Mus. Comp. Zool.*, Harvard, January, 1891.
[3] *Ibid.*, April, 1893.
[4] University of California Publications in Zoology, November 15, 1909.
[5] Richard G. Badger, 1919.
[6] "Unity of the Organism," Vol. 2, p. 204.
[7] "The Origin of Life" (Trans. by S. Morgulis), Macmillan, 1938.

chemical origin of living matter by making it plain why this process could hardly be expected to occur under present-day conditions.

"The Unity of the Organism" was surely a valuable contribution to the literature of theoretical biology, and may still be read with profit twenty-five years after its publication. It is packed with important material, interestingly presented, and much of the discussion is still stimulating. Ritter, I think, was disposed to magnify the differences between his own points of view and those held by other biologists whom he characterized as "elementalists," a circumstance which gave to some of his utterances a needlessly disputatious tone. This was accentuated by his failure, at times, to discern the meaning behind the esoteric sounding terminology of the rather bumptious young science of genetics. Again, Ritter's own utterances did not always lack a cabalistic tinge, as when he asserts his belief that "every living individual organism has the value, chemically speaking, of an elementary chemical substance"; and he gives no biochemical grounds for the hypothesis that all manifestations of life, including the psychical ones, "result from the chemical reaction between the organism and the respiratory gases"—oxygen being almost certainly the effective one. Even the format was against the success of "The Unity of the Organism." One does not ordinarily look beneath such small covers for a work of so considerable importance.

Dr. Ritter's last work of book dimensions, and certainly one of his best, was "The California Woodpecker and I," to which we must add the subtitle so characteristic of the author, "A Study in Comparative Zoology, in which are set forth numerous facts and reflections by one of us about both of us."[8] The volume as a whole is as unique as the title, comprising sections designated "Chiefly Woodpeckers," "Chiefly Both of Us," "Mind, Brain, Conduct," and "Chiefly Myself." Here we are taken in review through Ritter's own more than twenty years' observations on the acorn-storing and other instincts of this remarkable bird, followed by excursions into anatomy, physiology, phylogeny, psychology, sociology, epistemology and ethics! The reader may fail to detect any great degree of coherence at all points in the narrative, but that is not necessary to the enjoyment of it.

No account of Professor Ritter's career would be at all complete without considerable mention of the Scripps Institution at La Jolla, which may, to a certain extent, be regarded as his monument. The Scripps Institution for Biological Research was the outcome of a series of endeavors by Dr. Ritter and some others to create a seaside laboratory in connection with the department of zoology at the University of California. These earlier ventures, commencing as far back as 1892, included the establishment of very temporary quarters successively at Pacific Grove, Santa Catalina Island, San Pedro, Coronado and within the village of La Jolla. Building upon the present grounds was commenced in 1909, and two years later the then "San Diego Marine Biological Association" deeded the property to the University of California, under the title "Scripps Institution for Biological Research." Omission of the word "marine" was deliberate.

It was during this period of unrestricted biological outlook that the present writer became a member of the institution's staff, and for many years thereafter my studies of the races of wild mice were regarded as altogether relevant to the liberal, if somewhat nebulous, "program" of the "Biological Station" Indeed, generous funds were allotted to them throughout. Mr. Scripps's own avowed interests were in human problems, and in biological problems only in so far as they might have human implications. At one time he became mildly interested in a project to establish a colony of anthropoid apes upon our campus, and somewhat later even a department of sociology. But neither enterprise got beyond the talking stage. However, Scripps's own support of the institution was primarily in behalf of Ritter. He more than once said that what he and his sister were really doing was "endowing Ritter," but this was probably a bit of Scrippsian hyperbole.

As already intimated, the first plan of Ritter and his associates had in view the building up of a marine biological station. Writing as late as 1911, he stated his program as being, in essentials, "a biological survey of the waters of the Pacific adjacent to the coast of Southern California." Rather a stupendous project those will say who have had anything to do with biological surveys! Later, as stated, the word marine was dropped, and mice and monkeys were regarded as germane to our "program." But the next tack in our institution's somewhat variable course took it well to seaward again. The word "oceanographic" was incorporated into the official name of our station, and the new director, succeeding Dr. Ritter upon his retirement, was selected with particular view to his qualifications in this field.

The motives behind this change on Ritter's part are somewhat inscrutable. Its wisdom, at the present date, is a purely academic question. The Scripps Institution of Oceanography is very much a going concern, even under wartime conditions. Most fortunately the word "oceanography" has been interpreted very broadly by both of Ritter's successors, and biological work, though changed somewhat in scope, has been liberally supported.

Dr. Ritter's cooperation with E. W. Scripps and others in the founding of the well-known scientific news agency, Science Service, can hardly be discussed

[8] University of California Press, 1938.

here, though it is important to note that it was to Ritter to whom Scripps intrusted the task of interesting and organizing the scientific supporters of the enterprise.

To all who really knew him William E. Ritter looms large, not only as a most lovable personality but as a scientist of much originality and forcefulness. His constant interest, both in the scientific achievements and the personal welfare of the members of his staff at the Scripps Institution, was an outstanding feature of our lives throughout his term as director. Every new bit of information gathered by one of us, whatever its subject matter, seemed to fit in some way into his framework of thought, and often as not served to illustrate some one of his favorite ideas. He was fond of discoursing with us, singly or in groups. These discourses were often stimulating. But we did not always find them easy to follow. Former President Wheeler, of the University of California, once characterized Ritter, so I am told, as "a great soul struggling for utterance." But this epigrammatic description hardly does him justice, for these "struggles" were not infrequently productive of impressive results.

FRANCIS B. SUMNER

DEATHS AND MEMORIALS

GEORGE STEIGER, chief chemist, retired, of the U. S. Geological Survey, died on April 18 at the age of seventy-five years. He joined the survey in 1892 and was chief chemist from 1916 to 1930.

DR. ROGER CLARK WELLS, chief chemist of the U. S. Geological Survey, died on April 19 at the age of sixty-seven years. He had been connected with the survey since 1908, succeeding Mr. Steiger as chief chemist in 1930.

ALBERT HIGGINS SLUSS, professor of mechanical and industrial engineering at the University of Kansas, died on April 17 at the age of sixty-six years.

DR. HERBERT A. CLARK, physicist of the Taylor Instrument Company at Rochester, N. Y., a former professor of physics at Syracuse University, died on April 20. He was sixty-eight years old.

A LIBERTY ship will be named for the late Dr. William E. Ritter, co-founder and honorary president of Science Service. The *S. S. William E. Ritter* will be launched early in May.

SIR ROY FEDDEN will give next month the thirty-second Wilbur Wright Memorial Lecture of the Council of the Royal Aeronautical Society, London.

SCIENTIFIC EVENTS

A GOVERNMENT TESTING LABORATORY IN SOUTH AFRICA

IT is reported in *Industrial Standardization* that in order to safeguard the public and to aid in checking quality and performance of materials and manufactured products, the South African Standards Institution has recommended that a National Standards Testing and Investigational Bureau be set up by the Government. Such a bureau would act as a national standardization laboratory and would carry out or arrange for investigations and tests in connection with standardization. The institution recommended that this bureau be established by Act of Parliament as a corporate body.

The functions of the bureau would include the testing and calibration of precision instruments, gages and scientific apparatus; determining their degree of accuracy with regard to fundamental standards, and issuing certificates with regard thereto. Testing and investigations on behalf of the South African Standards Institution and others would be done either by delegating the work to approved institutions or by providing laboratory facilities. Such testing would include physical or chemical examination of materials and products and tests of their use and performance.

The bureau would also assist the South African Standards Institution in investigating any questions affecting the preparation of its standard specifications. It would provide facilities for testing goods, articles and materials purchased on specification to decide whether such materials comply with the specification, and would act on behalf of the Government in testing locally manufactured and imported goods with a view to determining whether the goods comply with the regulations laid down by the Merchandise Marks Act or any other act and to verify standards. It would also test manufactured products and carry out investigations and inspections to enable the South African Standards Institution and other standardizing bodies to control their marks. In addition to all this, it is suggested that the bureau could also assist the Government departments in any tests which might need to be undertaken.

THE AMERICAN MATHEMATICAL SOCIETY

MEETINGS of the American Mathematical Society are announced for April 28 and 29 at Columbia University, and on the same dates at the Museum of Science and Industry, Chicago. On Saturday, April 29, there will be a meeting at the University of California at Berkeley.

At Columbia University, by invitation of the Pro-

gram Committee, there have been arranged three addresses: on Friday on "Mathematical Aspects of the Boundary Layer Theory," by Professor K. O. Friedrichs, of New York University; on Saturday at 11:00 A.M. on "The Structure of Normed Abelian Rings," by Professor E. R. Lorch, of Columbia University, and at 2:00 P.M. on "Modern Algebra and the Riemann Hypothesis," by Professor André Weil, of Lehigh University. Sessions for research papers have been arranged for Saturday afternoon.

At Chicago, at 2:00 P.M. on Friday, two invitation addresses were planned—one by Professor J. L. Synge on "The Problem of Saint Venant for a Cylinder with Free Sides," and one by Professor I. S. Sokolnikoff on "Torsion and Flexure of Compound Prisms."

At the University of California, on Saturday, there will be addresses by Professor D. H. Hyers, of the University of Southern California and the California Institute of Technology, on "Linear Topological Spaces," and by Professor R. M. Robinson, of the University of California, on "Hadamard's Three Circles Theorem." A symposium on applied mathematics will be held in the afternoon. The program will consist of two addresses: "Hydrodynamical Stability," by Dr. C. C. Lin, and "The Intrinsic Theory of Elastic Plates and Shells," by Dr. Wei-Zang Chien, both of the California Institute of Technology.

THE CHARLES L. MAYER AWARDS

THE National Science Fund of the National Academy of Sciences announces two Charles L. Mayer Awards for contributions on the nature of light submitted before January 1, 1946.

A prize of $2,000 will be awarded for "an outstanding contribution to our basic understanding of the nature of light and other electromagnetic phenomena which provides in terms intelligible to the community of scientists at large a unified understanding of the two aspects of these phenomena which are at present jointly described by wave and by corpuscular theories."

The second prize of $2,000 will be awarded for an outstanding comprehensive contribution to "a logical, consistent theory of the interaction of charged particles with an electromagnetic field including the interaction of particles moving with relative high speeds."

The first award is intended to encourage for the benefit of the non-specialist the interpretation of facts already known to the specialist. It is hoped that the second award will stimulate attack on one of the most fundamental unsolved problems in physics.

In making these awards the National Science Fund will have the assistance of a special advisory committee, consisting of Dr. E. U. Condon, associate director of the Research Laboratories, Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa.; Dr. Karl K. Darrow, a member of the technical staff of the Bell Telephone Laboratories and secretary of the American Physical Society; Dr. Robert A. Millikan, chairman of the executive council of the California Institute of Technology, and Dr. I. I. Rabi, professor of physics at Columbia University.

Contributions may be submitted to the National Science Fund of the National Academy of Sciences, 2101 Constitution Avenue, Washington 25, D. C.

GRANTS OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES

THE Permanent Science Fund is administered by a committee of the American Academy of Arts and Sciences. At a meeting of the council on April 12, the grants listed below were approved.

To Theodor von Brand and W. Gardner Lynn, Catholic University of America, Washington, D. C., for special equipment for use in the investigation of metabolic rates in turtle embryos, $80.

To Curtis L. Newcombe, associate professor of biology, College of William and Mary, Williamsburg, Va., for assistance in a further study of the larval stages of *Volsellia demissus*, the ribbed mussel, a source of food, $600.

To Frances A. Schofield, adjunct professor of chemistry, Randolph-Macon Women's College, Lynchburg, Va. To provide assistance and expendable materials in a further study of glycogen forming activity of alanine isomers, $500.

To Abraham M. Shanes, instructor in physiology, College of Dentistry of New York University, for assistance in extending a study of bioelectric potentials, $450.

Communications in respect of the fund should be addressed to Professor John W. M. Bunker, Massachusetts Institute of Technology, Cambridge, Massachusetts.

SCIENTIFIC NOTES AND NEWS

DR. ALBERT G. HOGAN, professor of animal husbandry at the University of Missouri and chairman of the department, has been awarded the Mead Johnson and Company Vitamin B Complex Award for 1944 by the American Institute of Nutrition. The award is "in recognition of his pioneer work on certain aspects of the vitamin B complex, work which has progressed successfully for many years and which

has contributed materially to the modern knowledge of vitamin B."

THE Herty Medal of the department of chemistry of the Georgia State College for Women will be presented on May 6 to Dr. James Edward Mills, chief chemist of the Sonoco Products Company, Hartsville, S. C. The medal, named after the late Charles H. Herty, known for his work on the production of paper from southern pine, is awarded annually for an "outstanding scientific contribution to the South."

THE Gold Medal for 1944 of the American Institute of Chemists has been awarded to Dr. Willard H. Dow, president of the Dow Chemical Company, in recognition of his work in making available supplies of magnesium for airplane construction and styrene for synthetic rubber.

DR. ARTHUR STOLL has been awarded the Flückiger Gold Medal in recognition of his scientific achievements in the field of pharmacy. This medal is the highest Swiss award for research work in pharmaceutical science and is bestowed every five years. The Marcel Benoist Prize for 1942 of the Marcel Benoist Foundation for the Furthering of Scientific Research has also been awarded to Dr. Stoll in recognition of his "outstanding contributions to pharmaceutical chemistry, particularly the isolation and synthesis of pure active principles of drugs." This prize is given for a scientific achievement or study which is of importance to human life. It is awarded every five years to a citizen of Switzerland or to an investigator having resided for at least five years in that country. Dr. Stoll has donated the sum of 20,000 francs accompanying the award to a foundation for the furthering of science.

THE Hinchley Medal of the British Association of Chemists has been awarded to Herbert W. Rowell, in recognition of "his long service to the association and his distinguished career in applied chemistry."

DR. E. V. MCCOLLUM, professor of biochemistry at the School of Hygiene and Public Health of the Johns Hopkins University, has been elected a foreign member of the Swedish Academy of Sciences.

DR. WARREN B. MACK, head of the department of horticulture of the Pennsylvania State College, vice-president of the American Society for Horticultural Science, in recognition of work in the graphic arts, has been made an associate of the National Academy of Design.

THE Ohio State University will confer at its spring convocation the doctorate of science on Dr. Thomas Midgley, Jr., of Worthington, Ohio, this year president of the American Chemical Society.

DR. STEPHEN J. ZAND, director of the Vose Memorial Laboratory of the Sperry Gyroscope Company at Great Neck, L. I., has been elected a fellow of the Royal Aeronautical Society, London.

DR. HUGH S. CUMMING, U. S. Surgeon General, retired, director of the sanitary bureau of the Pan American Union, was elected president of the fifth Pan American Conference of National Directors of Health at the Washington meeting, which opened on April 22.

SIDNEY D. KIRKPATRICK, editor of *Chemical and Metallurgical Engineering*, a director of the McGraw-Hill Book Company, has been elected president of the Electrochemical Society.

THE election as president of the Society of Chemical Industry, London, is announced of Dr. Eric Keightley Rideal, F.R.S., since 1930 professor of colloid science at the University of Cambridge. He will take office in July.

THE ninety-first chapter of the Society of the Sigma Xi was established on April 14 at Emory University, with Dr. G. A. Baitsell, national executive secretary, as the installing officer. The ceremonies were attended by some thirty-four official delegates and representatives from other universities. The installation address was given by Dr. E. Carroll Faust, of Tulane University, who spoke on "Some Biological Interrelationships." The following officers were elected: *President,* O. R. Quayle; *Vice-president,* E. L. Jackson; *Treasurer,* Miss E. Papageorge; *Custodian,* W. B. Redmond; *Secretary,* R. T. Lagemann.

DR. CLEMENT C. WILLIAMS, since 1935 president of Lehigh University, will retire on June 30.

DR. HERBERT JOHN FLEURE, professor of geography at the University of Manchester, has been appointed under the Rallman Foundation visiting professor of geography at Bowdoin College for the year 1944–45. He expects to arrive during the latter part of September and will begin his work at the college on October 5 at the beginning of the fall trimester.

DR. JOHN T. TATE, dean of the College of Science, Literature and the Arts of the University of Minnesota, who has been on leave since 1941, has asked to be relieved of administrative responsibilities. On completing his work with the National Defense Research Committee he will return to the university as research professor of physics. He is succeeded as

dean by Dr. T. R. McConnell, professor of educational psychology, who has been acting dean since 1941.

DR. ARNOLD DEMERRITT WELCH, director of the Division of Medical Research of Sharp and Dohme, Philadelphia, has been appointed professor of pharmacology at the Medical School of Western Reserve University.

DR. WILLIAM H. ADOLPH, for the past ten years chairman of the department of chemistry at Yenching University, Peking, has been made acting professor of biochemistry and nutrition in the School of Nutrition of Cornell University.

DR. GEORGE S. AVERY, professor of botany at the Connecticut College, New London, has been appointed, effective in July, director of the Brooklyn Botanic Garden to fill the vacancy caused by the death on August 9, 1943, of Dr. C. Stuart Gager.

DR. LAWRENCE C. CURTIS, geneticist at the Connecticut Agricultural Experiment Station, a member of the staff for fourteen years, will serve as assistant to Stanley L. Morse, agricultural consultant, who is at the head of a food mission to North Africa with the Division of Relief and Rehabilitation of the Foreign Economic Administration. The mission, composed of a group of agricultural experts chosen from various fields, will study the production of food crops in North Africa and the distribution of these crops to the Allies and to liberated countries.

DR. VERN O. KNUDSEN, dean of the Graduate Division of the University of California at Los Angeles, has returned to the university, following a leave of absence of nearly three years to enable him to undertake scientific war work for the Government. He has been active in devising new instruments and techniques of warfare in two of the divisions of the National Defense Research Committee. He will continue his work for the committee in an administrative capacity.

DR. EDGAR DOUGLAS ADRIAN, professor of physiology at the University of Cambridge, gave the second Pilgrim Trust Lecture before the National Academy of Sciences on April 24. He spoke on "Brain Mechanism."

PROFESSOR EDWARD KASNER, of Columbia University, recently gave at St. John's College, Annapolis, lectures entitled "The Golden Section in Mathematics and Art" and "Cartography, Old and New."

THE H. B. Shmookler Memorial Lecture of the Mount Sinai Hospital, Philadelphia, will be given on May 1, at 9 P.M., by Dr. John P. Peters, professor of medicine at Yale University. The lecture will be entitled "Planning for Post-War Medicine."

AT a meeting of the Council of the American Association of Pathologists and Bacteriologists held on April 8, it was voted that, unless unforeseen circumstances arise, the next annual scientific sessions of the association will be held at the University of Chicago on May 4 and 5, 1945. The symposium selected for the meeting is "Infectious Granulomas, exclusive of Tuberculosis and Syphilis." Dr. Wiley D. Forbus, professor of pathology at Duke University, will be the referee.

THE National Science Fund of the National Academy of Sciences announces that the offices of the fund are being moved to the National Academy of Sciences, 2101 Constitution Avenue, Washington 25, D. C, from 515 Madison Avenue, New York City. Headquarters will be established in Washington as of May 1.

THE National Foundation for Infantile Paralysis has made a two-year grant amounting to $34,080 to the School of Health of Stanford University to be used for the support of a school for technicians in physical therapy and for preparing materials for the use of instructors and students. Under this program selected women students will be provided with specialized training.

ACCORDING to the *Journal* of the American Medical Association, on January 12 the Bolivian branch of the International College of Surgeons was founded in La Paz in the presence of the former United States ambassador to Bolivia, Pierre de Boale, and Dr. Ernesto Navarro, vice-president of the University of La Paz. The chairman of this new institution, Dr. Enrique St. Loup, in his inaugural address stated that the Bolivian branch of the institution was founded in response to an invitation received a year ago from the headquarters of the college in Washington, D. C. The program of this first meeting included the exhibition of a La Paz film showing the different phases of a subtotal thyroidectomy.

THE special correspondent of *The New York Times* at Lima, Peru, reports that under an agreement signed by Dr. Constantino Carvallo, Peruvian Minister of Public Health and Social Welfare, and Major General George C. Dunham, assistant coordinator and director of basic economy in the Inter-American Affairs Coordination Office in Washington, D. C., the Inter-American Cooperative Public Health Service will be

continued for three years from July 1, 1944, when the pact signed in 1942 expires. Of the $1,000,000 to be spent on health and sanitation during the period of the new agreement, half is to be provided by Peru and half by the Institute of Inter-American Affairs.

BY the will of Henry E. Sever, the Chicago publisher, St. Louis University will receive the sum of $3,318,000. According to the daily press, Judge Joseph A. Graber, of the Cook County Superior Court, was directed to select a university or college in Missouri and award to it $100,000, plus whatever remained in the estate after other bequests had been made. Four institutions were surveyed by a committee of three members--Kansas City University; Washington University, St. Louis; the University of Missouri, and St. Louis University. It was directed that the bequest be used for the founding of a technological institute to bear the name of the donor. St. Louis University plans to establish the Sever Institute of Geophysical Technology.

AN Institute of Textile Technology has been established in Charlottesville, Va., by trustees representing twenty-eight textile mills in the East. Its purpose is to maintain an educational institution and to promote scientific research and processes related to the textile industry. The charter provides that none of its profits shall go to any member or individual and expressly prohibits its use of propaganda designed to influence legislation. Ward Delaney, of Charlottesville, has been named president. Arthur M. Allen, of Providence, is secretary.

A SCHOOL OF TECHNIQUES will be held this summer at Wellesley College. Its general aim is to enable the men and women who enroll to increase their proficiency in the techniques used in some special field or fields. In science there will be classes in chemistry, biology, geology, physics and mathematics. In addition students will have an opportunity of studying writing and the use of bibliographic material. Courses will be offered in conversation and the translation of foreign languages.

THE first issue has appeared of *Tropical Medicine News*, to be published bi-monthly as the official organ of the American Society of Tropical Medicine under the editorship of Dr. Joseph S. D'Antoni, secretary of the society. The *News* will be issued on about the twentieth of the month in February, April, June, August, October and December, the months in which *The Journal*, also a bi-monthly publication, does not appear.

EFFORTS are being made to produce varieties of potato resistant to disease and suited to conditions in various parts of the British Empire. It has been shown that the diverse qualities desired must be sought among potatoes indigenous to Central and South America, and a large collection of such types, wild and cultivated, has been formed at the School of Agriculture, Cambridge. Lord Nuffield and the trustees of the Nuffield Foundation have now authorized grants of about £9,000 for capital expenditure on this research. The money will be devoted to the housing of the collection and the work connected with it.

Nature writes that "in 1940 the Medical Research Council, the Ministry of Information and the editorial department of the British Medical Association decided to send abroad abstracts of important articles in British medical journals, and Dr. Howard Jones was appointed to do this work under the direction of the editor of *The British Medical Jounral*. By the end of 1941 a British Medical Information Service had been formed, and the British Council, which had supported the work from its inception, took it over as a permanent part of its work. *The British Medical Bulletin* is published in English, Turkish, Portuguese and Spanish, and Dr. Howard Jones, who is now a whole-time officer of the British Council, has made it a valuable addition to medical literature."

IN the course of an address given on March 2 before the London University Conservative Association, Oliver Lyttleton, British Minister of Production, is reported in *The Times*, London, to have said: "In endeavoring to regain its great trading position after the war, to improve the standards of life and to make its contribution towards balanced international trade, we should promote first research and development. The world is not the same world in 1944 as it was in 1939, and it would be different again in 1946. The primary producing countries would become industrialized to some extent. We shall be required to supply a new world with new goods, to fill a new demand with a new product. To do this we must devote our national ingenuity and resources towards research and development. If our scientists and research workers applied to our post-war problems, in a new field of production, the ingenuity they had shown in the war we might well regain the same position that we occupied when we were the first country to apply coal to the generation of power and when we led the world in the development of the railway. The question whether we were to be a poor nation or a rich nation depended entirely upon whether we used our brains or not."

DISCUSSION

SAFETY OF MECHANICAL RESUSCITATION APPARATUS

Preliminary Statement: Immediately following the publication in SCIENCE (December 24, 1943) of an article by the late Professor Yandell Henderson attacking the Council on Physical Therapy of the American Medical Association, a reply was prepared in which it was pointed out that SCIENCE, then edited by J. McKeen Cattell, should have submitted the attack to the council for its reply before publication. Unfortunately, both Professor Henderson and Dr. Cattell became ill and their deaths occurred soon after the publication of the article. This made it necessary for the council to revise its reply.

THE late Professor Yandell Henderson wrote an extensive paper entitled "The Return of the Pulmotor as a 'Resuscitator': A Back-Step toward the Death of Thousands," which was published in SCIENCE for December 24, 1943. He raised the question of the safety, efficacy and dangers of mechanical resuscitators and particularly charged the Council on Physical Therapy with inefficiency, unfair tactics and professional incompetence by accepting the E & J resuscitator.

Some of the statements of Professor Henderson are incorrect, some misleading and others unwarranted. This brief reply is for the information of the medical profession and the public.

Professor Henderson claimed that mechanical devices for artificial respiration known as resuscitators are essentially identical with a device formerly known as the pulmotor. The latter device, he asserted, was discredited by a Committee on Resuscitation from Mine Gases (about 1912), of which he was a member. The council does not propose any defense of the pulmotor, although he, as a member of the council at the time when that body first undertook to investigate resuscitators, was, of course, aware that the modern devices are essentially different from the pulmotor since they incorporate mechanisms for the control of pressure. In the resuscitators accepted by the council, dangerous pressures are not produced and evidence is available to indicate that the maximum positive pressure of 13 mm of mercury created in them is less than that which a human being can voluntarily produce in his own lungs without discomfort.

Professor Henderson wrote, "A delay of even a few seconds while apparatus is being brought and applied may lose a life." With this statement the council is in full accord. The council has urged[1, 3] that attempts should be made to train every competent person in the proper method of administering manual artificial respiration and that such methods should be applied at the earliest possible moment, even when awaiting the arrival of official agencies with such apparatus as they may have available. Manual methods should be applied whether those administering first aid are expecting the arrival of either an inhalator or a resuscitator.

He wrote, "In this respect, the American Medical Association is in direct antagonism to the American Red Cross." Actually the council has never voiced a criticism of any position taken by the American Red Cross regarding artificial respiration, it has repeatedly advocated the Red Cross training of persons giving first aid in the manual methods.

Both the title and the body of the article imply that the use of resuscitating devices will destroy life "by the thousands." The council has made repeated diligent efforts to ascertain instances in which loss of life or injury has been caused by the resuscitators that have been accepted. Not a single instance has been discovered in which either the opinion of a competent clinician or a post-mortem report would support the contention that loss of life or injury occurred due to the use of an accepted resuscitator.

The original reports mentioned by Professor Henderson appeared some thirty years ago and concerned devices the use of which has long since been discontinued. Again and again he was requested to submit a single authentic instance of loss of life because of the use of an accepted resuscitator, but not a single instance was submitted by him.

In his presentation, Professor Henderson insinuated a lack of "moral sense" in members of the Council on Physical Therapy because they accepted resuscitators without examination by any of them and asserts that this has been admitted by members in their letters to him. Actually, in 1937, two members of the council trained in physiology and medicine made careful experimental investigation of this equipment in the laboratories of the universities with which they are associated. Moreover, individual members of the council made independent investigations. Still further, the council consulted extensively with the late Dr. Pol Coryllos,[2] recognized as an authority in surgery of the chest, who had used the E & J resuscitator extensively in his own practice, had published papers concerning its use and had available evidence in the form of motion pictures as records of his experimentation. The records of the Council on Physical Therapy indicate that three other investigators, one of whom is a professor of physiology in one of the leading universities of the United States, submitted information and advice in relationship to the acceptance of the E & J resuscitator. Thirty-nine individual physicians submitted reports of cases which they had treated with this device and the vast majority of such reports were favorable to its use.[3] Dr. Ben Martinez submitted 500

[1] Annual Report: Council on Physical Therapy, *Jour. Am. Med. Asn.*, 118: 1468, April 25, 1942.

[2] P. N. Coryllos, "Mechanical Resuscitation in Advanced Forms of Asphyxia: A Clinical and Experimental Study of the Different Methods of Resuscitation," *Surg., Gynec. and Obst.*, 66: 698, April, 1938.

cases[4] in which newborn infants had been resuscitated with this device. In the consideration of other resuscitating devices additional evidence has been submitted. Finally, reports were made available of incidents in which rescue teams had used the resuscitator, and this material is available as part of the report on the survey of methods for artificial respiration by Dr. Bernard D. Ross.[5]

Professor Henderson referred to the original adverse report which he wrote for the council in May, 1934, on the E & J resuscitator and made the statement, "but at that point unfortunately the E & J Company learned—or were informed—that the report was adverse." The invariable practice of the council is to transmit to any firm which submits equipment a copy of the report on the device whether favorable or unfavorable. In the case of the E & J resuscitator the usual routine was followed.

Again Professor Henderson stated that the original adverse report was suppressed by the Board of Trustees of the American Medical Association. This statement is untrue. In view of further evidence which became available previous to the publication of Professor Henderson's report, the council became convinced that the report should be held in abeyance until further and more extended studies could be made. Again he implied that the ultimate acceptance of the E & J resuscitator was the result of improper influence exerted by the firm on the secretary of the council. This statement is untrue. The decisions of the council are solely those of its members. The secretary of the council does not have a vote for acceptance or rejection. The secretary of the council is not a physician. Such opinions as he submits are purely with relationship to physical or engineering aspects of the devices under consideration.

Again Professor Henderson implied that the secretary of the council did not refer to that body his invitation to delegate a subcommittee to join with him in testing a resuscitator on animals. Here are the facts: A bulletin is sent to all members of the council every two weeks. Professor Henderson wrote on November 30, 1938, that he had borrowed an E & J apparatus and could retain it only until December 15. In the bulletin dated December 8 appeared the reply which was made to him. Actually Professor Henderson acknowledged receipt of this letter on December 13. In the article, Professor Henderson charged that the secretary did not reply. Certainly it was impossible to appoint a subcommittee, arrange a meeting and provide transportation within the fifteen-day limit that he mentioned.

In the booklet of the Council on Physical Therapy called "Apparatus Accepted" appears a statement regarding resuscitators and inhalators and also a complete description of the prone pressure method. Professor Henderson was himself coinventor of the Henderson & Haggard inhalator which he claimed had "never been patented." A patent number appears on the device, but that patent is not assigned to him. The council has accepted the appliance.

The available evidence indicates that by far the great majority of those well informed regarding inhalators, resuscitators or other devices in the field of physical therapy have confidence in the objective attitude and integrity of the Council on Physical Therapy of the American Medical Association.

Members of the Council

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Anthony C. Cipollaro, M.D., associate in dermatology, New York Post Graduate Medical School, Columbia University, New York.

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W. E. Garrey, Ph.D., M.D., professor of physiology, Vanderbilt University School of Medicine, Nashville, Tenn.

Frank H. Krusen, M.D., professor of physical medicine, Mayo Foundation, and head of the Section on Physical Medicine, Mayo Clinic, Rochester, Minn.

Frank R. Ober, M.D., John B. and Buckminster Brown clinical professor of orthopedic surgery and assistant dean, Harvard Medical School Courses for Graduates, Boston.

George Morris Piersol, B.S., M.D., professor of medicine, Graduate School of Medicine, University of Pennsylvania, Philadelphia.

H. B. Williams, Sc.D., M.D., Dalton professor emeritus of physiology, Columbia University College of Physicians and Surgeons, New York.

[3] "E & J Resuscitator and Inhalator Acceptable." Report by Council on Physical Therapy, *Jour. Am. Med. Asn.*, 112: 1945, May 13, 1939.

[4] D. Ben Martinez, "The Mechanical Resuscitation of the Newborn: Report of 500 Cases," *Jour. Am. Med. Asn.*, 109: 489–490, August 14, 1937.

[5] Bernard D. Ross, "A Survey of Methods for Artificial Respiration," *Jour. Am. Med. Asn.*, 122: 660, July 3, 1943.

THE OCCURRENCE OF A TETRAPLOID AND TWO TRIPLOID APPLE SEEDLINGS IN PROGENIES OF DIPLOID PARENTS

It is usually assumed that triploids originate spontaneously with a relatively low frequency in diploid material. The relatively high proportion of triploid apples found among the leading varieties of the world would seem to indicate that certain desirable characteristics in apple varieties may be associated with triploidy itself or that triploids arise spontaneously, presumably through the functioning of unreduced gametes, with a much higher frequency in apples than hitherto has been suspected.

To test the frequency of occurrence of triploids from diploid parents a beginning was made by determining the chromosome numbers of 278 apple seedlings from crosses made during the course of the breeding program at the New York State Agricultural Experiment Station at Geneva. The crosses were made on March 27, 1942, on potted trees in the greenhouse. The seed was stratified and the seedlings started in the greenhouse in the spring of 1943. Just before they were moved into the nursery, in late May, root tips were taken from each seedling for chromosome number determinations. These determinations were made during the winter of 1943–44.

In a population of 146 seedlings from the cross, Delicious × Bedford, 2 triploids were found. In the nursery these made an average growth during the season of 1943. In a population of 94 seedlings from a cross of Macoun × Jonathan, a tetraploid seedling was found. This seedling has disappeared from the nursery either through accident or failure to become established.

If the true frequency of spontaneous occurrence of triploids and tetraploids in apples approaches the frequency here observed in a population of only 278 seedlings, it would seem to be a relatively easy matter to obtain these forms. A larger number of observations are of course necessary before a reliable value for the frequency of occurrence can be established.

John Einset

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THE CORRECT GENERIC NAME FOR THE SAND FLY

Writers of text-books on parasitology and medical entomology have for the past fifty years insisted upon using the wrong generic name for the Psychodid fly which is the vector of Leishmania, *Bartonella bacilliformis* and pappataci fever.

The generic name used in text-books is *Phlebotomus;* whereas, the correct name is *Flebotomus.* Rondani in 1840 (*Mem. Prima Serv. Dipt. Ital.*, p. 12) erected this genus on a species from southern Italy. Why the spelling has changed from *Fle* to *Phle* is not known; unless it was to make it easier to pronounce, as *Phlebotomus* and *Flebotomus* are homonyms.

This mistake should be rectified and the correct name *Flebotomus* should be used. There is no reason to continue with this mistake in our medical and parasitology literature. Careless mistakes of this type are responsible for the over-abundance of synonymy in our taxonomic literature. Furthermore, it is time medical men and entomologists got together and used the same name, *Flebotomus.*

William F. Rapp, Jr.

Chatham, N. J.

THE LONGEVITY OF THE EMINENT

In a recent article in Science,[1] Lehman expresses doubt as to the validity of the curvilinear relationship which I had found between mean age at death and the degree of eminence attained by American physicians.[2] He failed, however, to suggest any reason why this should be considered illogical or of doubtful significance. Certainly the medical and biological sciences abound with this type of relationship. There would seem to be no basis for their non-acceptance except for purposes of mathematical correlation.

Lehman also claims that my conclusions were one-sided, with undue emphasis on the late death-age of the most noted physicians and neglect of a similar late age for those receiving least death-column space. It is true that the final paragraph of my article dealt mainly with the advantages to society of a late death-age for its most renowned members, but isn't such emphasis justified?

Lehman has presented no published statistics in this field, but he does state that his unpublished data show no consistent difference in death-age between the great and near-great in various fields of endeavor. However, like Rendich,[3] he failed to divide his material in any one class into more than two groups—the great and the near-great. With only the two observational categories, it is obvious that his data could not bring out even the strongest curvilinear relationships which might be present.

Until some one presents valid evidence to the contrary, acceptance should be given to my findings of late mean death ages for the most eminent and least eminent physicians and a significantly earlier age at death for those of only moderate fame.

Clarence A. Mills

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[1] Science, 98: 270, September 24, 1943.
[2] Science, 96: 380, 1942.
[3] *Jour. Am. Med. Asn.*, 119: 1041, 1942.

SCIENTIFIC BOOKS

PLANT GEOGRAPHY

An Introduction to Historical Plant Geography. By E. V. WULFF. 1943. Authorized Translation by E. Brissenden. Waltham, Mass.: the Chronica Botanica Co.; New York, N. Y.: G. E. Stechert and Co., pp. xv + 223. $4.75.

IN the great period of DeCandolle, Forbes, Darwin, Hooker, Wallace and Gray, the importance of plant geography was widely recognized; but the developments of ecology in the present century have tended to divert attention from the wider aspects of plant distribution, even although ecology can make important contributions to the problems involved. An introduction to historical plant geography is, therefore, to be welcomed, and should find a place in every general botanical library. It is valuable not only for the data it presents, but because of their bearing on paleobotany, climatic and geological changes, as well as the problems of plant migration, selection, speciation and adaptations for dispersal.

The author is a Russian, who is thus able to introduce to English-speaking readers much Russian work in plant geography as well as an excellent summary of the whole field. It is to be hoped that a *History of the Floras of the World,* which he has also completed, can appear too in an English translation. In the present volume Dr. H. M. Raup has added a compact statement with references to the recent American work, necessitated by the isolations of the war.

The eleven chapters of this book are concerned with such topics as the scope and history of plant geography; areas—their origin, centers and types; the evidence from geographical distribution of hosts and parasites; wind, water and animals as factors in plant dispersal; the migration of species and floras; the historical causes for the present composition of floral areas; and the concept of floral elements.

The author has decided views, which he applies whole-heartedly to the solution of the many complicated problems and puzzles of plant distribution. He accepts the Age and Area conception as one of many factors at work in determining the present distribution of the earth's population of plant species. His discussion of the impact of the ice age on plant distribution in northern latitudes might have been more extended, but this is an introduction to the subject. A feature which he emphasizes is that not only cultivated plants but the weeds which infest them have, through man's partly unconscious action, lost their power of independent existence in competition with wild plants. He holds, with DeCandolle and Willis, that species generally advance very slowly into new areas, the process frequently necessitating a physiological process of acclimatization. This can hardly apply, however, to such species as *Argemone Mexicana,* which can be seen naturalized in India from the Himalayas to Cape Comorin.

In his discusion of methods of dispersal, the author places a minimum value on their efficiency. He points out, for example, that although the gigantic seeds of the double coconut (*Lodoicea*) have for centuries been thrown up on the coasts of the Indian Ocean, yet this palm remains endemic to the Seychelles alone. If ocean currents have not resulted in successful dispersal in this case, can they have done so with the coconut (*Cocos*) or with the seeds of many other plants? It is now generally conceded that man carried the coconut across the Pacific. Even the transport to distant islands of seeds from edible fruits by birds is made to appear very doubtful.

On the other hand, pollen is known to be carried hundreds of miles by winds, reaching over 10,000 feet in the air. Despite this disadvantage, the study of pollen in peat-bogs and other semi-fossilized conditions has acquired great importance in connection especially with post-glacial deposits and the conclusions which can be drawn from them regarding plant distribution. The recent book by Erdtman[1] in the same series is a timely review of the whole field.

Another interesting feature of Wulff's treatment of plant distribution is his acceptance of continental drift as a working hypothesis, made all the more necessary if the plant's "adaptations" for dispersal have such a limited success. Here the last word is likely to be with the geologists, and some of their recent pronouncements indicate that the controversy will be a lively one before it is settled. One geological difficulty appears to be that Pangaea only began to split apart towards the end of the Mesozoic period, although in earlier ages Eurasia (and perhaps also North America) was sundered by the shallow Tethys sea. What produced this belated instability of the previously single continent?

In his foreword, Dr. Merrill points out another difficulty: the genera of plants common to the two hemispheres are but 6.4 per cent. of the total. Whether this is a real difficulty, however, depends largely on the geographical nature of the process of speciation, regarding which, especially in the tropics, we at present know very little.

Wulff admits that Wegener's hypothesis requires modification, and that unsolved difficulties remain regarding the Pacific Ocean. But the facts of distribution clustering around the conceptions of Gondwanaland, Lemuria and Antarctica are so suggestive, and these conceptions solve so many difficulties that the hypcthesis is bound to remain very attractive to botanists, especially as it appears to solve also the other-

[1] *An Introduction to Pollen Analysis.* By G. Erdtman.

wise insoluble problem of "shifting of the poles" and accompanying climatic changes.

Apart from all matters of controversy, this volume, with its accumulation of facts and literature, will be of great service to all who are interested in problems of distribution.

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ORGANIC CHEMISTRY OF SULFUR

The Organic Chemistry of Sulfur. Tetracovalent Sulfur Compounds. By CHESTER MERLE SUTER. 858 pp. 6 × 8½ in. Bound in dark green cloth New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd. $10.00. 1944.

THE author states in the preface that this book is intended to serve as a reference work for those interested in the chemistry of those organic sulfur compounds which, broadly speaking, may be regarded as derivatives of sulfuric acid. The chapter headings are, therefore: I. Esters of Sulfuric Acid (94 pp.); II. Aliphatic Sulfonic Acids (101 pp.); III. The Preparation of Aromatic Sulfonic Acids (186 pp.); IV. The Properties and Reactions of Aromatic Sulfonic Acids (71 pp.); V. and VI. Derivatives of Aromatic Sulfonic Acids. 1. Sulfonyl Halides, Esters, and Anhydrides (121 pp.), 2. Sulfonamides and Related Compounds (85 pp.); and VII. Sulfones (117 pp.).

Encyclopedic in the field it covers, it is a veritable mine of information. References to all important literature on the subject, as recorded in *Chemical Abstracts* up to January 1, 1942, and totaling many thousands, are included. In recognition of the vast amount of time and labor which the author has expended in the preparation of a volume which makes all organic chemists his debtors, it is to be hoped that the welcome accorded it will be correspondingly cordial and that in due course of time we shall see from his pen other volumes treating with similar thoroughness and skill the remaining branches of the subject.

Each chapter opens with a detailed table of contents, showing the order in which the subject matter is classified and presented, and closes with a consolidated register of the references cited in the text. In addition to these references, there are innumerable tabular lists of compounds distributed throughout the text. Methods of preparation, general properties and reactions, derivatives of various kinds, industrial and medical applications, all are discussed in due course. A comprehensive index (83 pp.) is supplied.

In its chosen domain, the book is *facile princeps*, and is most heartily recommended. In paper, type, printing and binding, the book is fully up to the usual high Wiley standards.

MARSTON T. BOGERT

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INDUSTRIAL CHEMISTRY

Industrial Chemistry. By WILLIAM THORNTON READ. 3rd edition. v + 631 pp. New York: John Wiley and Sons, Inc. 1943. $5.00.

THE third edition of Professor Read's well-known volume follows very closely the general plan and arrangement of previous editions.

A first section of six chapters discusses the approach to chemical engineering and serves as an excellent elementary introduction for readers who may be generally interested in the subject or who are approaching it for the first time.

The next four chapters discuss materials and equipment and are designed to give the general reader an introduction to the subjects of unit operations, materials of construction, power plant chemistry and related matter. The remaining seventeen chapters, 450 pages, are devoted to about twenty of the chemical industries of outstanding importance.

The volume represents a thorough revision of the previous editions and brings all the subjects treated up to date except for progress in the war interests. The author notes that the present world situation throws most statistical matter out of balance, and therefore, in general, bases economic data and so forth on the prewar figures.

About thirty pages of new matter have been added, including especially additions in the chapters on rubber, plastics and protective coatings; and, in fact, all the chapters represent much more than a revision of previous manuscript since in most cases the material is entirely rewritten.

The book is very readable, and the concise, entertaining style of the author is evident throughout, though the author has had the cooperation of recognized authorities in each field treated. The book should be welcomed by all those who have found the first and second editions useful and should reach a wide circle of new readers.

W. D. TURNER

COLUMBIA UNIVERSITY

PHYSICAL BIOCHEMISTRY

Physical Biochemistry. By HENRY B. BULL. New York: John Wiley and Sons. iv + 340 pp. $3.75. 1943.

THIS book is a short summary of many physicochemical principles and methods which have been applied in biochemical research. A noteworthy feature is the large number of references to the literature, particularly that of the last decade. More space is devoted to the presentation of principles than to the discussion of their application. While some of the equations are logically derived from fundamentals, many others must be accepted on faith. Particular

mention should be made of the author's discussions of dielectrics, electrokinetics, viscosity, diffusion and membranes, since these topics have been neglected in many elementary text-books.

In general the treatment is clear and accurate, but there are occasional lapses. The definition of the erg (p. 15) is grossly incorrect. The author implies (p. 108) that Harned and Ehlers did not use buffered solutions, while as a matter of fact their precise values for dissociation constants were obtained only by the use of buffer mixtures. A method for extrapolating electromotive force data (p. 110) is presented in a sadly garbled form. The name of the man who formulated the law of diffusion (p. 272) should not be identical with that of an American steel magnate. The method of obtaining partial specific volumes would be more intelligible if the words (p. 292, line 4) agreed with the symbols. However, most of the errors will be caught by a careful reader.

The lectures on which this book was based were probably a pretty stiff dose for the medical and biological students who heard them. The book should be particularly useful to future research workers who are willing to supplement it, as the author suggests, by a generous amount of outside reading.

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SPECIAL ARTICLES

SUPPRESSION OF GROWTH OF THE BROWN-PEARCE TUMOR BY A SPECIFIC ANTIBODY

THE cells of the Brown-Pearce carcinoma possess a distinctive constituent which can be identified *in vitro* through its reaction with an antibody that appears in the blood of certain rabbits implanted with the growth, as previous studies have shown.[1] This constituent is regularly present in large amounts in cell-free, saline extracts of the Brown-Pearce tumor, but it has not been detectable in similar extracts of other rabbit tissues, normal or neoplastic; it is readily sedimentable in the high-speed centrifuge, and certain of its properties suggest that it may be a protein.[1, 2] Inquiry has now shown that the antibody which reacts specifically with the distinctive constituent has an influence on living Brown-Pearce tumor cells.

For *in vitro* experiments, serum specimens known from trial complement fixation tests[1] to contain the specific antibody in high titer were procured from "blue-cross" rabbits[4] in which the Brown-Pearce tumor had recently regressed. The sera were mixed with suspensions of living tumor cells, prepared by pressing "healthy" tumor tissue through a 40-mesh monel metal sieve into Locke's solution and allowing the clumps to settle out in a cylinder, the final preparations containing some 20 to 40 individually suspended tumor cells per microscopic field (×400). The mixtures were incubated 2 to 3 hours at 37° C. and then injected into the leg muscles of three or four normal rabbits. Control injections were made at corresponding situations in the same hosts with an equal quantity of incubated mixtures containing tumor cell suspensions and sera from normal rabbits or from rabbits carrying tumors of other kinds (V2 carcinoma;[5] Sarcoma 1 of Andrewes and Ahlström[6]). The control mixtures gave rise almost always to tumors that reached 2.0 to 3.5 cm in diameter within two to four weeks, whereas the tumor cells incubated with the antibody-containing sera usually failed to grow, though occasionally they formed small nodules.[7]

The effect was specific in that the antibody-containing sera had no influence on V2 carcinoma cells or those of Sarcoma I in concurrent tests. Yet the antisera did not lyse, agglutinate or alter the appearance of the Brown-Pearce tumor cells during 3 hours at 37° C.; and furthermore the proportion of tumor cells stainable with trypan blue (final concentration

[1] J. G. Kidd, *Proc. Soc. Exp. Biol. and Med.*, 38: 292, 1938; *Jour. Exp. Med.*, 71: 335, 351, 1940; *Jour. Bact.*, 39: 349, 1940. See also J. G. Kidd and W. F. Friedewald, *Jour. Exp. Med.*, 76: 543, 557, 1942.

[2] As bearing further on the nature of the distinctive constituent, recent experiments have shown that it is acted upon *in vitro* by purified proteolytic enzymes (chymotrypsin and trypsin), which rapidly render it unable to react with its specific antibody. In addition, Claude and I have found that the distinctive constituent seems to be associated with the "small particles" or cytoplasmic microsomes of the Brown-Pearce carcinoma cells—the finding having a greater interest since the filtrable agent responsible for Chicken Tumor 1 appears to be associated with the microsomes of fowl sarcoma cells.[3]

[3] A. Claude, *Proc. Soc. Exp. Biol. and Med.*, 39: 398, 1938; SCIENCE, 91: 77, 1940; J. Furth and E. A. Kabat, *Jour. Exp. Med.*, 74: 247, 257, 1941. See also L. Foulds, *Am. Jour. Cancer*, 31: 404, 1937; J. G. Kidd and W. F. Friedewald, *Jour. Exp. Med.*, 76: 543, 557, 1942; A. Claude, *Biological Symposia*, 10: 111, 1943.

[4] English × Lilac—Rockefeller Institute strain, inbred from fertile hybrids.

[5] J. G. Kidd and P. Rous, *Jour. Exp. Med.*, 71: 813, 1940.

[6] C. H. Andrewes and C. G. Ahlström, *Jour. Path. and Bact.*, 47: 87, 1938.

[7] It may be significant that the Brown-Pearce tumor cells do not "protect" the distinctive constituent from the action of the specific antibody, whereas many living cells, notably certain neoplastic ones, provide such protection for viruses.[8]

[8] P. Rous, P. D. McMaster and S. S. Hudack, *Jour. Exp. Med.*, 61: 657, 1935; J. G. Kidd, *Jour. Exp. Med.*, 75: 7, 1942.

1:300)[9] was no greater in incubated mixtures containing specific antisera than in control mixtures with normal sera. The pH of incubated mixtures ranged between 7.95 and 8.08 as determined with the glass electrode, those containing the specific antisera being no more alkaline than the controls.

With a view to testing for an effect of the specific antibody *in vivo*, attempts were made to stimulate its formation in normal rabbits by repeated intraperitoneal injections of watery, cell-free extracts of the tumor. The results were negative when agouti, chinchilla and Dutch hybrid rabbits were employed, though animals of these breeds may manifest the antibody following the growth of Brown-Pearce tumors.[10] In several experiments, however, blue-cross rabbits have developed the specific antibody following three or four intraperitoneal injections with cell-free extracts of the tumor, and all of the animals in which this happened (16 out of a total of 44) proved resistant, generally completely so, to a small "dose" of Brown Pearce tumor cells implanted intramuscularly 7 to 10 days after the final intraperitoneal injection.[11] By contrast, the blue-cross rabbits that had not developed detectable titers of the antibody as result of the intraperitoneal injections proved quite as susceptible as normal rabbits, the implantations resulting in large growths in most instances. Again the effect was specific in that the rabbits that had developed the antibody and were resistant to the Brown-Pearce tumor cells proved as susceptible as normal controls to implantation with tumor cells of other types (V2 carcinoma, Sarcoma I).

It is common knowledge that the Brown-Pearce carcinoma, like other cancers transplanted in hybrid hosts, is frequently resorbed after having attained considerable size. Yet many animals have overcome it in our experiments without manifesting the specific antibody in detectable titer at any of repeated bleedings, and sera procured from them have failed to influence the later proliferation of Brown-Pearce tumor cells when incubated therewith *in vitro*. Hence it seems plain that regression of the growth, at least as it occurs in many instances, is probably not brought about by the specific antibody.[12] Recent observations have shown, however, that the antibody may influence the course of events when it develops following the implantation of Brown-Pearce tumor cells. For in the rabbits that have developed the antibody in high titer under such circumstances the growths have almost always regressed abruptly within 3 or 4 weeks after the implantations, while, conversely, the animals in which the tumor has grown progressively and metastasized have usually had little or none of the specific antibody in their blood.[15]

The findings as a whole would seem to indicate that the specific antibody is capable of preventing the proliferation of living Brown Pearce tumor cells,[16] and they are consistent with the view that the distinctive sedimentable constituent with which the antibody reacts may play some part in the proliferative activities of the tumor cells. In further studies to determine whether the cells of other tumors possess distinctive constituents of similar sort, recent observations[21] have indicated that the V2 carcinoma regularly yields a sedimentable substance that is not detectable in extracts of normal rabbit tissues or in those of other

[9] A. M. Pappenheimer, *Jour. Exp. Med.*, 25: 633, 1917; M. N. Richter and E. C. MacDowell, *Jour. Exp. Med.*, 57: 1, 1933.

[10] I. MacKenzie and J. G. Kidd, *Jour. Exp. Med.*, in press.

[11] In this relation, MacDowell, Claude *et al.* observed in two experiments that 5 per cent. and 35 per cent., respectively, of the C58 mice injected intraperitoneally with sedimented materials procured from Line I leukemia cells later survive implantation with tumor cells that overcame the control animals (Carnegie Institution of Washington, Year Book No. 40: 248, 1940–41).

[12] It seems probable that isoantibodies such as those encountered by Gorer and by Lumsden in tumor-resistant mice and rats[13] might be responsible for regression of the Brown-Pearce carcinoma as this usually occurs. However this may be, experiments have shown that the specific Brown-Pearce antibody does not react with extracts of the normal tissues of tumor bearing, tumor-regressed or normal rabbits, and it does not lyse or agglutinate their erythrocytes—findings which render it unlikely that the Brown-Pearce antibody is an isoantibody of this kind. Nevertheless, it is obvious that genetic or constitutional factors influence the incidence of the specific antibody, though the nature of these factors remains obscure.

[13] P. A. Gorer, *Jour. Path. and Bact.*, 44: 691, 1937; *ibid.*, 47: 231, 1938, *ibid.*, 54: 51, 1942, T Lumsden, *Am. Jour. Cancer*, 32: 395, 1938. See also reference 14.

[14] M. J. Eisen and W. H. Woglom, *Cancer Research*, 1: 629, 1941.

[15] In an exceptional instance fulminant growth of the tumor brought about death of the host with widespread metastases on the 34th day after implantation, despite the development of a moderately high titer of the antibody between the 18th and 28th days.

[16] The principle is not new in immunology that antibodies may render cells unable to proliferate without altering appreciably their form or other functions, in this respect resembling certain chemotherapeutic agents.[17] Ascoli[18] and Dochez and Avery[19] have studied the "antiblastic" effects of certain antibacterial antibodies, and Taliaferro has described "ablastic" antibodies which prevent reproduction of *Trypanosoma lewisi* in the rat and *T. duttoni* in the mouse, an interesting fact being that the parasites remain alive, motile and capable of infecting new hosts after a sojourn of months in the blood of animals having effective titers of the ablastic antibodies.[20]

[17] H. Dale, *Lancet*, 2: 761, 1941, *Brit Med Jour.*, 2: 411, 1943; H. McIlwain, *Nature*, 151: 270, 1943. See also A. J. Clark, in Heffter's Handbuch der experimentellen Pharmakologie, Berlin, Springer, Erganzungswerk. 4, 1937.

[18] A. Ascoli, *Centr. Bakt. u Parasit.*, 1, Abt., Orig., 46: 178, 1908.

[19] A. R. Dochez and O. T. Avery, *Jour. Exp. Med.*, 23: 61, 1916.

[20] W. H. Taliaferro, *Jour. Exp. Med.*, 39: 171, 1924; *Am. Jour. Hyg.*, 16: 32, 1932; *Jour. Immunol.*, 35: 303, 1938.

[21] J. G. Kidd and W. F. Friedewald, unpublished experiments.

rabbit neoplasms, including virus papillomas of the type from which the V2 carcinoma originally derived.

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NEW YORK, N. Y.

A CONFIRMATION OF THE PRESENCE OF PANCREOZYMIN IN THE DUODENAL MUCOSA*

HARPER and Raper[1] have recently demonstrated that extracts of duodenal mucosa contain two hormonal agencies affecting the external secretory activity of the cat's pancreas. One of these is the familiar secretin; the other, heretofore not characterized, they have termed pancreozymin; their findings indicate secretin to stimulate the production of fluid and bicarbonate by the pancreatic acini, whereas pancreozymin does not affect the output of the inorganic constituents and causes a marked increase in the production of pancreatic amylase. By implication, all the pancreatic enzymes are similarly affected, since a parallelism in their appearance in pancreatic juice or pancreatic extracts has been repeatedly demonstrated. The obvious academic importance and practical implications of these studies by Harper and Raper clearly indicated that a re-examination be made of various fractions obtained in the isolation of secretin as performed in this laboratory,[2] with a view to substantiation of their findings in the dog and extension of their studies to the three chief pancreatic enzymes.

METHODS

Fasted mongrel dogs were anesthetized with sodium pentobarbital, the femoral vein exposed for intravenous injections, and the chief pancreatic duct (Santorini) cannulated. Three of the secretin concentrates previously described[2] served as the stimulating agents employed, including the crude preparation designated SI; the fraction precipitated by aniline treatment of a solution of SI in 80 per cent. acetone, designated AP in the present discussion; and an aqueous solution of the material purified by treatment of SI with aniline, followed by butyl alcohol extraction, which on treatment with picrolonic acid yields a crystalline picrolonate. All materials were free of vasodilator activity; they were injected intravenously, and the first sample following a given injection was discarded, as it served to flush the ducts and cannula of pancreatic juice resulting from a previous stimulation. Enzymes determined included amylase, trypsin and lipase; they were estimated by the methods previously employed.[3] The volume and enzyme responses were noted following injections of pure secretin and of pure secretin plus the AP fraction before and after a six hour incubation with dog serum. The latter procedure was designed to determine whether pancreozymin is inactivated by serum in a manner analogous to secretin.[4]

RESULTS

It was found in every case that purified secretin evoked a secretion poor in enzymes. Either the SI fraction or purified secretin combined with the AP fraction evoked a secretion with a markedly increased enzyme content, all enzymes being similarly affected. Incubation of the AP fraction with serum vitiated its enzyme-stimulating properties. The averaged results are listed in Table 1.

TABLE 1

Stimulus	No of dogs	Volume	Trypsin Units per cc	Trypsin Units total	Amylase Units per cc	Amylase Units total	Lipase Units per cc	Lipase Units total
Secretin ..	10	3.0	367	1,101	0.148	0.444	172	516
Secretin + AP	10	3.2	1,403	4,500	0.412	1.320	865	2,760
Secretin + serum treated AP	5	4.1	314	1,285	0.152	0.624	166	680

DISCUSSION

On the basis of the results submitted it is evident that the AP fraction contains a principle which stimulates production of enzymes by the pancreas; and these are washed out in the secretion stimulated by secretin. It is therefore evident that the findings of Harper and Raper are in all respects confirmed by the results of these experiments and that all pancreatic enzymes are equally affected. Thus separation of secretin and pancreozymin was effected by us some years ago, without a recognition on our part that this had been done. The failure of the pancreozymin fraction to stimulate enzyme production after incubation with serum signifies that there is a substance in the blood, probably an enzyme, which with time inactivates pancreozymin.

SUMMARY

Confirmatory evidence has been secured for the existence of pancreozymin, a hormone present in extracts of the duodenal mucosa the effect of which is to stimulate enzyme production by the pancreas. It is separated from secretin by precipitation with aniline, and stimulates equally the formation of the three chief

* Aided by grant from Josiah Macy Jr. Foundation.

[1] A. A. Harper and H. S. Raper, *Jour. Physiol.*, 102: 115, 1943.

[2] H. Greengard and A. C. Ivy, *Am. Jour. Physiol.*, 124: 427, 1938.

[3] M. I. Grossman, H. Greengard and A. C. Ivy, *Am. J. Physiol.*, 138: 676, 1943.

[4] H. Greengard, I. F. Stein, Jr., and A. C. Ivy, *Am. Jour. Physiol.*, 133: 121, 1941.

pancreatic enzymes; it is inactivated by incubation with serum, probably on an enzyme basis.

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CHLORELLIN, AN ANTIBACTERIAL SUBSTANCE FROM CHLORELLA

Cultures of *Chlorella,* in inorganic nutrient solutions, produce and accumulate a substance that tends to inhibit further multiplication of the cells.[1] Recently extracts containing this growth-inhibiting substance have been prepared in larger quantities than heretofore and have been tested for antibiotic activity against other organisms. These extracts have been found to possess antibacterial properties against both Gram-positive and Gram-negative organisms: *Staphylococcus aureus, Streptococcus pyogenes, Bacillus subtilis, Bacterium coli* and *Pseudomonas pyocyanea* (*Ps. aeruginosa*).

Both *Chlorella vulgaris* and *Chlorella pyrenoidosa,* commonly considered to be different species, were used in these experiments. The cells were cultured in batteries of 5-gallon bottles containing solutions of the conventional mineral nutrients for pure algal cultures. Various proportions and concentrations of these salts were tested. The more dilute solutions, and those containing ammonium nitrogen, were all sterilized before inoculation. With more concentrated solutions,[1] sterilization was not essential when the solutions were continuously illuminated. A mixture of 5 per cent. carbon dioxide in air was bubbled continuously through the cultures. Some cultures were grown under continuous illumination from white fluorescent lamps for about two weeks. Others were grown in a greenhouse under natural illumination for approximately one month, finally being subjected to continuous illumination from fluorescent lamps for two to three days. Best yields of antibacterial substance were obtained from mature cultures which were harvested immediately after the above mentioned period of illumination.

Various methods have been used to obtain extracts containing the active principle. Crude extracts, suitable for determining the biological activity of the inhibitory substance, were prepared by extraction of the cell-freed culture solutions. For these extractions chloroform, 1,2-dichloroethane or benzene have proven superior to other solvents tried. The separated organic solvent, used for extraction, was removed *in vacuo* and the crude extract was obtained as a brown mass, in yields of 1 to 8 mg per liter of cell-free solution. The consistency of the crude extracts varied from a viscous, tacky liquid to a brittle solid. In some instances, extraction of the cell-freed culture solution was preceded by concentration to one half volume by distillation *in vacuo* at bath temperatures of 50–55° C. Thus far adsorption and elution techniques have been inferior to the extraction procedure. Active material has also been obtained from the cell mass. Apparently moderate heat does not greatly affect the yields of the active material.

Biological tests were carried out on clear aqueous extracts of the crude material. To this end the crude material was thoroughly shaken with a small amount of water. Such a procedure has commonly yielded solutions containing 0.03 to 0.1 mg solids per cc. This solution was adjusted to pH 7.0. When tested against *Staphylococcus aureus,* strain 209, in standard cup assay (18 hours at 37° C., diameter of cup 8 mm) 0.2 cc portions of these solutions commonly produced zones of inhibition 18 to 35 mm in diameter. A zone of 45 mm was obtained from extracts of one lot of crude material. Attention should be directed to the fact that only a very small portion of the active principle is extracted in a single treatment by this procedure, for repeated extractions of a given lot of crude material continue to yield solutions showing a relatively high order of antibacterial activity. The same order of activity was observed when strains of *Str. pyogenes* (on blood agar) or of *B. coli* were substituted as the test organism. The strain of *Ps. pyocyanea* that was used is only slightly less sensitive to the action of this antibacterial agent, while the strain of *Bac. subtilis* is more sensitive than the staphylococcus

Other tests indicate that the active principle may be bactericidal. One tenth of a cubic centimeter portions of 24-hour broth cultures of *Staph. aureus* were added to 5 cc portions of solutions having the same concentration of active principle as were used in the cup tests. Less than 10 minutes contact with the active principle prevented subsequent multiplication of the organisms when transferred to nutrient broth (incubated at 37° C. for 48 hours). Contact of about 20 minutes was required in the case of *B. coli* to achieve the same result. Similar tests in which the bacterial cells were exposed to the solution of the active principle in fresh rabbit serum showed that the bactericidal activity of the active principle is but slightly inhibited in the presence of serum proteins.

The results of numerous experiments carried out over a period of a year and a half show that an antibacterial substance accumulates in uncontaminated cultures of *Chlorella* and that the activity of this substance can be tested by standard bacteriological methods. For convenience of reference it is proposed to designate this substance by the name ***chlorellin.*** **It is recognized that the products thus far obtained repre-**

[1] R. Pratt, *Am. Jour. Bot.,* 27: 52 and 431, 1940; 29: 142, 1942.

sent crude extracts. Considerable work will be required to determine fully the range of biological activity and the chemical nature of the active principle. In view of the low and variable yields thus far obtained it is apparent that further work is necessary to determine the optimum conditions for the accumulation and extraction of chlorellin. The cell mass may prove to be a valuable source of the active principle. These investigations are progressing.

Chlorellin is unique in the constantly growing list of antibiotics which have been reported in the literature, because, since it is derived from an autotrophic organism, its production does not entail the use of expensive and troublesome organic culture media, only inorganic salts, carbon dioxide and light being required.

These investigations have been carried out as a coöperative project by staff members of the College of Pharmacy of the University of California and of the Division of Plant Biology of the Carnegie Institution of Washington.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

NEW INDICATORS TO REPLACE LITMUS IN MILK

THE use of litmus milk has gained wide popularity in bacteriological procedures because of the large number of biochemical reactions that can be determined with one inoculation. It has been our experience to find it very difficult to duplicate the density of the color. This may be due to the fact that litmus is not a single substance but a mixture which varies with the lichen and preparation used.

A search for a single compound which would serve both as a pH indicator and an E_h (oxidation-reduction) indicator in the proper ranges proved disappointing. A combination of indicators was decided upon, and those embodying the most desirable properties both alone and in combination were Chlor Phenol Red (or Brom Phenol Red) for the pH indicator and Methylene Blue for the E_h indicator.

Chlor Phenol Red is a member of the sulfonphthalein dyes which are widely used in bacteriological media. The pH range is from 5.2 to 6.8. Its yellow color on the acid side and red color on the basic side does not mask the reactions of the Methylene Blue. A stock solution is prepared by dissolving 0.1 gram in 10 cc of absolute alcohol.

The Methylene Blue stock solution is prepared by dissolving 0.625 grams (total dye concentration 84 per cent.) in 250 ml of distilled water. The stock solutions are kept in well-stoppered light-tight bottles.

The formula for the preparation of the milk is as follows:

Dry milk powder	90 grams
Chlor Phenol Red (stock solution)	1 ml
Methylene Blue (stock solution)	2 ml
Water	make up to 1 liter

The milk is then sterilized by the fractional method or autoclaved at 15 pounds for 15 minutes. The color of the milk changes to a light pink when strongly heated, but the original color returns as the milk cools.

Autoclaved milk requires a somewhat longer time for acid coagulation, but this is foretold by the very rapid reduction of Methylene Blue in this reaction.

The color changes in the milk as compared with Ridgeway's Color Standards (1912) are summarized as follows:

Uninoculated	Pale Glaucous Green
Slightly acid	Yellowish Glaucous
Acid with reduction	Ivory Yellow
Alkaline	Pale Russian Blue
Alkaline with reduction	Pale Pinkish Cinnamon
Alkaline peptonization	Clear Transparent Red

Inoculation of organisms of known biochemical character readily overcomes confusion in transposing the same reactions found on litmus milk.

This medium has been successfully used in a number of beginning and advanced classes in bacteriology. Students using milk for the first time have no difficulty in determining the reactions which have taken place.

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BOOKS RECEIVED

ABRAMS, LEROY *Illustrated Flora of the Pacific States.* Volume II *Buckwheats to Kramerias* Illustrated. Pp viii + 635 Stanford University Press $7.50

WEIDENREICH, FRANZ *The Skull of Sinanthropus Pekinensis, A Comparative Study on a Primitive Hominid Skull.* Illustrated Pp xxi + 484 Published by the Geological Survey of China. For sale at the office of G E Stechert and Company.

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BRAIN MECHANISM[1]

By Dr. EDGAR DOUGLAS ADRIAN, F.R.S.

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I CAN think of no better way of beginning than by recalling another function due to the Pilgrim Trust at which I was present six months ago. I recall it in gratitude to a foundation which has preserved so much that is worth preserving in Great Britain, and because this particular occasion concerned a scientist who might be claimed from both sides of the Atlantic, since he belongs to the period of our common ancestry. The occasion was the presentation by the Trust to Trinity College, Cambridge, of some of the private library of Sir Isaac Newton, scholar and fellow of the college and afterwards president of the Royal Society. The presentation was made in the great library built by Christopher Wren at the request of Isaac Barrow, the master of Trinity who recognized the genius of Newton and did all he could to foster it, and the books are now in the shelves at the south end of the library near the Newtonian telescope and the statue of Lord Byron.

The war has prevented an international celebration of three famous men who were born or died 400, 300 and 200 years ago, Copernicus, Newton and Lavoisier, and the Royal Society has been forced to honor its greatest president without the ample banquet which would normally have shown our devotion to science. But the meetings in his honor have made us more aware of those aspects of Newton's work which are overshadowed by the "Principia" and the "Optics." As far as mathematical physics was concerned Newton had only to be and all was light. But there is also the less triumphant figure, Newton the student of the occult, the interpreter of the book of Daniel, the half-believer in Hermetic secrets, who could scarcely bear to be distracted from these things by the mathematical problems which he could not resist solving, who spent the best years of his life in chemical experiments which have had no result. His

[1] The second Pilgrim Trust Lecture to be given in the United States. This address was delivered at the United States National Museum, Washington, D. C., under the auspices of the National Academy of Sciences, on April 24, 1944.

nephew, Humphrey Newton, has left us a picture of him working day and night in his rooms by the great gate of Trinity, with the furnace burning continually and the old, mouldy book on the transmutation of metals by his side. As a rule he seems to have enjoyed himself thoroughly, but it was here that ultimately the clouds gathered over his mind until his friends took him to London and gave him new and less exacting interests. It always gives me a thrill of pride to recall that I lived for four years in Newton's rooms in Trinity, but I have been glad that his great intellect had left no traces of its struggles to harass later tenants.

Stukeley in his memoir says, "As to chemistry we may presume Sir Isaac from his long application to that pyrotechnical amusement had made important discoveries in this branch of philosophy," and he repeats the story that Newton had written a treatise on chemistry which was unluckily burnt in a fire, though it seems that the little dog, Diamond, who is blamed for upsetting the candle is as apocryphal as Newton's cat and kitten. But fire or no fire Newton could scarcely have reached any general laws of chemical affinity, for so many of the relevant facts were not yet discovered. The whole mass of quantitative relations had still to be worked out, as the earlier astronomers had worked out the data of planetary motion. So Newton's natural philosophy deals only with matter in general and takes no account of chemical change.

It takes no account of life either, for Newton was not interested in living things. But I have not brought in the contrast between Newton the physicist and Newton the alchemist without a reason. It is that I proposed to talk of a subject which inherits some of the glamor of seventeenth century chemistry or alchemy. The physiology of the brain has not the economic attractions of the philosopher's stone but it has the same kind of appeal to our curiosity, to our desire to know more perhaps than is good for us. For other kinds of physiology may tell us about living matter, but the physiology of the brain might give the answer to some vital questions about our own minds and might even help to decide what sort of universe we are really in, whether it is the mechanical universe of the seventeenth century or something much more modern and uncertain.

Detailed knowledge of the brain is all of very recent date. In Newton's time it was known that the brain was in touch with the nerves from the sense organs, but up to 1860–1870 there was really nothing to show what sort of events took place in it. Then came the discovery of the speech centers by Broca and of the motor area by Hitzig and Fritsch and with that the search for mechanism in the brain could really begin. There were definite pathways and cell groups for particular operations, for the comprehension of words, for skilled movements and so on. The brain came to be thought of as a great mass of nerve cells and interlacing fibers, and the tracing of pathways through it became the main task of the neurologist. And this happened not so very long ago, for David Ferrier, one of the most successful pioneers in cerebral localization, used to visit the National Hospital at Queen Square when I was a resident there.

Between that time and the present, one of the major developments came from Sherrington's work on the spinal reflexes. This has a special claim to be mentioned here, for it was Sherrington's visit to Yale in 1905 to give the Silliman lectures which led to the publication of his book—"The Integrative Action of the Nervous System." This was an immediate classic. Sherrington's aim was to make the reactions of the spinal cord intelligible by analyzing them into their simplest components. To achieve simplicity the spinal cord had to be isolated from the brain which normally directs it. The spinal reflexes are therefore the reactions of a mutilated fragment of the nervous system and they are produced in a thoroughly artificial setting. But Sherrington's study of them showed first that in these simplified conditions they could be produced with mechanical regularity, and second that these simple reactions could be combined together so as to build up much more elaborate patterns of activity. After this work it seemed much more reasonable to speak of the mechanism of the spinal reflexes and to suppose that more complex behavior might come of their integration. It is true that nowadays the fashion is to decry this kind of analysis and to maintain that the organism can only be considered as a whole. We may have reached that stage, but we have learned a great deal from the analysis none the less. Sherrington himself was content with the activities which do not involve the cerebrum and would always be classed as reflex in spite of their complication, adjustments of posture and locomotion for instance. The cerebrum seemed to him to introduce quite a different order of complexity; and it was Pavlov who developed the idea of a truly mechanical brain—with the warning that we can not expect to understand the mechanism which underlies behavior if we speak or think of it in terms which imply the mind.

Pavlov's teaching, like Freud's, has been publicized too much and has suffered from it. It has left an enduring mark on neurology but much more as the basis of a particular technique of research than as the basis of a philosophy. For in the present period new information about the working of the brain has been accumulating at such a rate that the theories are scarcely worth making. As usual in physiology the

new information has come as the result of technical improvements in other fields, in brain surgery, in experimental psychology and particularly in the detection of small electric currents. I can only deal with a few lines of work which will show how things are developing. They may well make a familiar story to you since it is in the United States that much of the development has taken place, but it is this continued, rapid advance which is my main theme.

First of all we have had far more detailed studies of the mechanism of reflexes. Sherrington stimulated nerves and recorded the reflex contractions of individual muscles. In this way he could tell how faithfully the signals coming out of the cord to the muscles copied those which he had sent into it—whether the reflex pathway had inertia or was dead beat and what sort of changes occurred in it. But nowadays the signals which enter and leave the cord can be split up into the individual nerve impulses of which they are composed. These are recorded electrically and their appearance can be timed with an immensely greater accuracy. Recording the electric changes which accompany nervous activity is an old story: it was used by Gotch and Victor Horsley 50 years ago to trace the pathways of conduction from the brain to the cord, but the modern development, started by the work of Gasser and Erlanger at St. Louis, has now reached such precision that we can make a time table accurate to a ten thousandth of a second for each pulse of activity. And with micro-electrodes the search can be carried deep into the cell masses of the gray matter. But the outcome is still the same. When the conditions are standardized we find an exact precision of response within the central nervous system, a mechanical regularity extending to the units as well as to the summed effect of the whole mass of nerve cells and fibers. There is much more to be done, but so far there has been no hint of any processes outside the range of a mathematical universe.

But very naturally the reactions which are submitted to this kind of minute analysis are not a random sample. They are selected just because there is some chance that the analysis can be made, and nearly all of them have been reactions of the local executive parts of the nervous system, the spinal cord and the brain stem. If these parts are not directed by the brain the animal does act—or react—as if it were an automaton, with a mechanical regularity which allows us to predict exactly what it will do in the circumstances. In the intact animal there is the same local mechanism of nerve cells and fibers in the cord but it is made use of by the brain to bring about an entirely different sort of behavior—one which seems far less automatic. A brainless cat will lift its foot each time the skin is pinched, but a normal cat may do almost anything and will probably do something different each time. Evidently when the brain is in control the connection between incoming and outgoing signals is far more obscure.

Here we are still on the outskirts. A great deal is known about the nervous pathways in the brain and about the sort of activity which takes place in the nerve cells, but it does not get us very far. We are dealing with what seems to be no more than a great sheet of nerve cells linked by nerve fibers to some central cell masses and to the rest of the nervous system. We can be fairly certain, too, that its working must depend on the spatial distribution of activity in it. This is determined by the particular pathways which must be taken by the incoming and outgoing messages, for the messages are all in the same form wherever they come from and it is because they arrive in different regions that we interpret one as sight and another as sound. Thus if we look at a bright cross the initial event in the brain will be the development of cellular activity (which we can record electrically) in a more or less cross-shaped area at the back of the occipital lobe, and if we listen to a voice the same kind of activity will appear in the temporal lobe with a pattern, in space and time, corresponding to the areas of vibration in the cochlea. Probably each smell will influence the olfactory area in a similar way—we do not yet know enough to say what sort of shapes will correspond to—say—the smell of a violet or of an onion, but we can be fairly certain that all these different pictures—of visual, auditory, olfactory and tactile stimuli—are made up of the same elements, rapid sequences of nerve impulses distributed more or less thickly over the receiving areas and calling up more or less activity in the nerve cells there.

The detailed mapping of the patterns formed in the brain by the sense organs—the patterns which mirror the external world—is an achievement of the last few years and much of it has been done not 100 miles from where we are now. But it tells us only about the way in which information is sent into the brain and not about the way in which the brain reacts to it. In fact, the mapping has to be done in a brain which is anesthetized so that the sensory picture can stand out against a quiet background. Otherwise there would be a constantly changing activity to confuse the map. It is this activity, in all parts of the brain, which should tell us how the sensory pictures are recognized and used to guide our behavior, but to analyze it we need to know what is going on in the brain of a conscious subject. The arrival of a sensory message in the anesthetized brain is like the ringing of a telephone bell in a house where all the inmates are asleep. Naturally we should like to go on with the story, to find out what happens when the

nerve-cells are awake and can attend to the message, how they recognize the author of it and decide on the answer they shall give. In fact, we want to know what happens in the normal unanesthetized brain when a familiar sensory picture appears and calls up associations and movements.

Here there are only some odd scraps of information. The difficulties seem to be mainly technical. As far as we can tell any change in nerve cell activity should produce a corresponding change in the electric currents in the surrounding medium, and if we could record at will from any group of nerve cells in the brain we should be in a fair way to knowing what happens when a new sensory picture is thrown on the cortical surface. But in a man with an intact skull we can not place electrodes in immediate contact with the brain and so we can only record the average of all the electric changes over a fairly large area—the average activity of several million nerve cells and not the exact events in each. It is remarkable that such an average should give anything that can be recorded, but that it does so was shown 15 years ago by Hans Berger. Berger found that in a subject at rest and with eyes closed a regular series of potential waves could be detected by electrodes on the head. These come from the cerebral cortex and indicate an activity in the nerve cells over a fairly large area. But unfortunately Berger's α rhythm seems to be some sort of basic activity of the undisturbed brain. It has a fixed frequency (8–10 a second) and disappears as soon as visual attention is aroused. Thus the α waves can not tell us much about the specific activities by which the brain patterns are analyzed. One thing they can do, however, is to show something of the nervous processes which underlie a shift of attention from one field to another. In man, for instance, where vision is the predominant sense, the rhythm comes and goes whenever the attention is transferred from the visual field to the auditory and *vice versa*. From the size and distribution of the waves, therefore, we can form some idea of the extent of the brain surface which may be normally involved in vision and hearing.

The α waves show us no more than the basic rhythm of those parts of the brain which are awake but have little to do. But there is a further development which tells us something about the specific activities of the visual regions. It depends on forcing the nerve cells to work in unison by illuminating the field with a flickering light. When this is done the potential changes over the occipital region have a frequency corresponding to that of the flicker and are large enough to record through the skull. We have therefore what amounts to a method of tracing the visual signals in the brain, for we can make them fairly easy to recognize as long as the time sequence is preserved.

I will not trouble you with all the details of these flicker rhythms except to say that they seem to reveal an interesting borderland between the primary visual area and the rest of the brain. In this borderland (which extends well beyond the boundaries of the occipital lobe) the spatial as well as the temporal pattern of the excitation is preserved to some extent, but the spread of the visual signals into it is governed partly by the degree of attention given to the visual field, for the diversion of attention to another task will often disorganize the rhythm. And there are all sorts of interactions between the flicker rhythm and the α rhythm, which tends to reassert itself when attention weakens, and may combine with the flicker rhythm, if the two frequencies are suitably related, or may supplant it altogether.

Another point about the activity in this borderland area is that it is far from being an exact copy of the patterns of light and shade which fall on the retina. There is evidence of a good deal of interaction, not only between different points on the same side of the brain but between the two sides. For instance, if we look at a field of which only the right or the left half is flickering, the flicker potentials will appear on the opposite side of the head—this is where the signals of the flicker would arrive. But if the two halves of the field are made to flicker at different rates, my own brain, at any rate, gives up the unequal struggle and produces a confused medley of frequencies much the same on both sides.

In interpreting results of this sort it is very easy to be misled, for it is a long way from a flickering screen to the occipital lobes and a still longer way from there to the mind. The flicker waves do seem to be somewhere on the direct route, however, for when they change in rate or regularity there is usually a change in the sensation which has the same direction, faster or slower, though we may not be able to analyze it more precisely. Unfortunately with present techniques the method can only be applied to visual events. A repeated noise like that of a machine gun does not give a corresponding series of potential waves large enough to detect through the skull—either because they are not developed over a large enough area or because the area is unfavorably placed. I am afraid, therefore, that the present technique of recording brain events, by oscillographs connected with electrodes on the head, is not likely to lead very far. But such a technique may soon be superseded; judged by the standards of modern physics it is already obsolete, and I think we should look forward to the possibility of being able to record all the electrical events—the changing potentials and ionic move-

ments—within the brain in far greater detail and without hindrance from the skull.

What can we expect if such a development occurs, as I think it is bound to do sooner or later?—when we can study the whole changing pattern of activity in the cerebral hemispheres from moment to moment?

It will not necessarily tell us much about a most important and characteristic property of the brain, its power of learning, of forming associations or conditioned reflexes, for this must depend on changes which are persistent and may not give rise to electrical effects. In fact, it may need a biochemical and histological survey to show us why the dog comes to salivate whenever the dinner bell is rung. But an electrical survey could scarcely avoid giving some entirely novel information about what is happening in the brain when we think or solve problems or decide what to do. The progress of neurology has been full of surprises and it will not do to predict: but sooner or later we are likely to reach a position where some very fundamental problems ought to arise. For example, in the brain of a conscious man will there be the same mechanical precision in the response of nerve cells and cell masses to the signals which reach them? Isaac Newton in one of his few excursions into neurology remarks that "the soul may determine the passage of animal spirits into this or that nerve and so may cause all the motions we see in animals." Is there any chance that we shall reach a position where such a possibility might be put to experimental test?

I have the feeling that we shall always find a catch somewhere, as I suppose the alchemists always did when it came to the final moment of projection. The problem may become more and more meaningless as we seem to come nearer to it, or perhaps it will become obvious that it is not one which could ever be solved by beings like ourselves. However, this really does not matter, for we can be quite certain of one thing: whatever the final outcome of inquiries about the mechanism of the brain there is an immense amount waiting to be found out on the way. It is almost within our grasp even now. Before the war the younger generation of neurophysiologists were advancing at a pace which accelerated every year, and those of us who dated back to the string galvanometer were already out of breath. When they come back again we may confidently expect to be left so far behind that these philosophic speculations will be our only consolation. The alchemists may have wasted their time in futile attempts to reach a goal which was not there, but they turned into chemists soon enough. In the same way the search for the mechanisms of the brain, though its goal, as we see it now, is perhaps unattainable, may lead us to a new understanding of human behavior—a synthesis of physiology and psychology. And with that in mind we can end with another quotation from Newton—which sums up what I have tried to say:

> As in mathematics so in natural philosophy the investigation of difficult things by the method of analysis ought ever to proceed the method of composition; and if natural philosophy in all its parts by pursuing this method shall at length be perfected, the bonds of moral philosophy will also be enlarged.

OBITUARY

FRANCIS PERRY DUNNINGTON
1851–1944

FRANCIS PERRY DUNNINGTON was born in Baltimore on March 3, 1851. At the age of sixteen he entered the University of Virgina, where he remained until called by death on February 3, 1944, just one month before his 93rd birthday. He graduated with the B.S. degree in 1871 and the following year received the degrees of C.E. and M.E. In the same year he was made adjunct professor of analytical chemistry and was promoted to a full professorship in 1884. From 1908 to 1919 he was professor of analytical and industrial chemistry, after which he retired from active teaching. He was a fellow of the American Association for the Advancement of Science and held membership in the American Chemical Society, the British Association for the Advancement of Science, the Chemical Society (London), American Electrochemical Society, the Franklin Institute and Phi Beta Kappa. When the first edition of "American Men of Science" appeared in 1906, a star was prefixed to the word *Chemistry* following Professor Dunnington's name, which means that he was ranked among the leading thousand scientists in the United States and one of the 175 American chemists whose work at that time was considered to be the most important.

Professor Dunnington's early training in chemistry was under that most able teacher and great chemist, John W. Mallet. He was associated with Dr. Mallet until the latter's retirement in 1908.

When Professor Dunnington graduated in the early seventies, the demand for chemists in industry was small and so he embarked on a career of teaching and investigation. He became recognized as one of the outstanding analytical chemists of his time. His publications number 68, many of them being joint reports on work with his students. Perhaps his greatest contribution to science was the discovery of the extensive

occurrence of titanium in American soil and rocks. While he never engaged in industrial activities, his influence in this field was far-reaching and it must have been a source of great satisfaction to him to know that many of his students have contributed in a large measure to the development of American industries. His former students include many well-known chemists and engineers.

The Charles Herty Medal was awarded Professor Dunnington in 1935 by the Georgia State College for Women at Milledgeville, Ga., "for excellent service in the field of chemistry in the South . . . and especially for his splendid record as a teacher of chemists who have attained renown." The late Dr. Charles L. Reese, for many years chemical director at E. I. du Pont de Nemours and Company, and an old student of Professor Dunnington, has written affectionately of him in *Industrial and Engineering Chemistry* (22: 1408, 1930), under the caption "American Contemporaries." Here are mentioned many of his most prominent students. Dr. Reese's description of Professor Dunnington and a personal incident during his student days at the university are well worth quoting.

> Tall, red headed (but lacking the fiery disposition usually accompanying this characteristic), a gentle, kindly face—Dr. Dunnington presented an imposing personality. In addition to having the faculty of thoroughly imparting knowledge, he took a real personal interest in his students even to the extent of caring for them when they became ill. I recall vividly an instance in my own case when I was a student at Virginia. I had been suffering from an ailment and Dr. Dunnington one day noticed my apparent indisposition. He promptly sent me to his own home, where his kind hospitality and watchful care were extended to me until I was restored to normal health. Thus, his home came to be regarded by his students as a sort of haven to which they could go in times of distress, whether physical, mental or spiritual. The very atmosphere of his home, made more charming by the presence of his lovely wife and children, was an inspiration. He was imbued with a radiating spirit of brotherly love that endeared him to his associates, and outside of his duties of teaching chemistry "he went about doing good."

Professor Dunnington's activities were not confined to university duties. He always took an active interest in the welfare of the community. The installation of a modern sewage system for more than a hundred buildings in the university area was due to his efforts and personal supervision. This and many other local civic improvements are the result of his efforts. For many years he was an elder in the Presbyterian Church in Charlottesville and he was an ardent supporter of the cause of temperance. After his retirement from teaching in 1919, he devoted himself to a number of activities, much time being spent cataloguing the chemical museum of the Cobb Chemical Laboratory, working on the solubility of borates and writing several philosophical articles from a religious standpoint. Until recent years when his health began to fail, Professor Dunnington spent many pleasant hours working in his garden and each fall would gather baskets of apples and pears which he enjoyed giving to friends.

Francis Perry Dunnington, known affectionately by his former students and friends as "Old Dunny," will long be remembered as an exceptional teacher—patient, thorough, kind-hearted and fair. He emphasized the importance of being able to do a job with the materials and apparatus at hand, and by his own ingenuity in this respect he developed this worthwhile trait in his students. In his passing, the University of Virginia and the city of Charlottesville, where he lived and labored for more than three quarters of a century, have lost one of their great personalities. He was a scholar, a scientist, a teacher and a Christian gentleman of the Old South.

John H. Yoe

RECENT DEATHS

Dr. James Conner Attix, since 1904 until his retirement in 1943 professor of chemistry and toxicology at Temple University, Philadelphia, died on April 20 at the age of seventy-four years.

Franklin B. Hanley, instructor in geology at the University of Minnesota, died on April 24 at the age of forty-five years. Mr. Hanley had been on leave from the university since June, 1942, to serve as executive secretary at the Naval Radio and Sound Laboratory at San Diego, Calif.

Charles E. Hellmayr, associate curator of birds of the Chicago Natural History Museum, has died in Switzerland at the age of sixty-six years. He was the principal author of "The Birds of the Americas."

Dr. James Crawford Simpson, who retired in 1941 as professor of histology and embryology and dean of the faculty of medicine of McGill University, died on April 20 in his sixty-eighth year.

SCIENTIFIC EVENTS

THE PROPOSED NATIONAL RESEARCH COUNCIL FOR INDIA

The National Institution of Sciences of India, according to *Science and Culture*, Calcutta, has passed the following resolutions advocating the founding of a National Research Council.

> (1) That it is necessary to establish at an early date a National Research Council of India under the statutory authority of the Government of India.

(3) The purpose of the National Research Council shall be:

(a) to plan and watch over the main lines of research and technical developments in accordance with national needs to see that the application of science to the public welfare is adjusted to some consistent plan, to advise the Government on a common policy and to insure that available resources for research and developments are distributed to the best advantage of the country;

(b) to advise and help relevant authorities and institutions regarding the training and supply of scientific personnel for pure and applied research, and

(c) to distribute grants for promoting approved researches, for the maintenance of selected research scholars, for scientific publication and other purposes.

The president of the National Research Council shall be a member of the viceroy's cabinet.

For the performance of its functions, the National Research Council shall, in consultation with non-official scientific organizations, universities and institutions of a university rank, scientific departments of the Government and federations of chambers of commerce, constitute the following boards of research, each of which will be responsible within its own particular sphere for giving effect to the policy of the National Research Council.

(1) Board of Scientific Research (mathematics, statistics, physics, chemistry, botany, zoology, geology, geography, psychology, etc.).

(2) Board of Agricultural Research (soils, crops, animal husbandry, fishery and forestry).

(3) Board of Medical and Public Health Research, including medical science.

(4) Board of Engineering Research, including mining, metallurgy and such other boards as may be considered to be necessary.

For the purpose of its work each board will be authorised to constitute research committees for all important subjects, to settle the objects of the research, indicate the individuals or organizations which could undertake the several component parts of the inquiry, receive and coordinate the information, make it available to those who will turn it to advantage to form a national plan into which all who are in position to contribute information can fit the particular lines on research. Governing bodies of the National Research Laboratories when established shall be constituted in consultation with the relevant research committees.

The National Research Council shall work in close cooperation with the development organizations in the country. To enable effect to be given to the policy of scientific development determined by the National Research Council the Government should make an annual grant of at least five crores of rupees.

THE WISCONSIN ACADEMY OF SCIENCES, ARTS AND LETTERS

The seventy-fourth annual meeting of the Wisconsin Academy of Sciences, Arts and Letters was held on April 14 and 15 at the University of Wisconsin. Approximately a hundred members and guests gathered to hear the address delivered by the retiring president, Dr. A. W. Schorger, president of the Burgess Cellulose Company, Madison. The title of his address was "The Abundant Life." Dr. Leon J. Cole, professor of genetics at the university, showed colored motion pictures illustrating the life of the fur seals of the Pribilof Islands. Dr. Schorger was elected a life member of the academy.

The following officers were elected to serve in 1944:

President, Dr. H. A. Schuette, department of chemistry, University of Wisconsin.

Vice-president in Sciences, Ruth Walker, Milwaukee.

Vice-president in Arts, Walter Bubbert, Milwaukee.

Vice-president in Letters, Dr. Helen White, department of English, University of Wisconsin.

Secretary-Treasurer, Dr. Banner Bill Morgan, parasitologist, department of veterinary science, University of Wisconsin.

Librarian, Halvor O. Teisberg, University Library, University of Wisconsin.

Curator, Dr. Edward P. Alexander, superintendent of the Wisconsin State Historical Society, Madison.

Member, Committee on Publications, Dr. Philo M. Buck, Jr., professor of comparative literature, University of Wisconsin.

Members, Library Committee, Dr. O. L. Kowalke, professor of chemical engineering, University of Wisconsin; Professor Ruth Marshall, Wisconsin Dells; Dr. James F. Groves, department of biology, Ripon College; and Dr. W. N. Steil, Marquette University, Milwaukee.

Representative on the Council of the American Association for the Advancement of Science, Dr. Banner Bill Morgan.

Approximately twenty-four papers were presented at the regular sessions, including ornithology, botany, mammalogy, bacteriology, plant pathology, zoology, limnology, entomology, protozoology, chemistry, forest products, medicine, soils and agriculture.

Dr. Michael F. Guyer, professor of zoology at the university, presented a memorial tribute to the late Professor Chancey Juday, life member and past-president of the academy.

THE CHICAGO CONVENTION OF FOOD TECHNOLOGISTS

The fifth annual meeting of the Institute of Food Technologists will be held under the presidency of W. V. Cruess on May 29, 30 and 31 at the Edgewater Beach Hotel in Chicago. Major General S. G. Henry, director of New Developments Division, Office of Chief of Staff of the U. S. War Department, will deliver the keynote address on "The Food Technologist's Role in the War." George A. Sloan, president

of the Nutrition Foundation, Inc., of New York, will follow with an address entitled "The Role of Industry in Strengthening Fundamental Research."

Technical sessions are set for Monday afternoon and for Tuesday morning and afternoon. Roy C. Newton, of Swift & Company, Chicago, will discuss "The American Food Supply" at the luncheon on Tuesday, which will be presided over by M. L. Laing, of Armour and Company, chairman of the Chicago Section.

The annual banquet will be given on Tuesday evening when presentation will be made of the 1944 Nicholas Appert Medal Award, established in 1941 by the Chicago Section, to Dr. C. A. Browne, of the U. S. Department of Agriculture, "for outstanding contributions to food technology." Following the presentation, Dr. Browne will speak on "The Keeping Qualities of Sugars and Sugar-Containing Products During Storage." The banquet will be concluded with an address by William A. Patterson, president of the United Air Lines.

The last day of the convention will be devoted to a discussion of post-war problems relating to the food industry Two general sessions and a luncheon program have been arranged. R. C. Newton will preside at the luncheon and Mr. Cruess will make an address entitled "Taking Stock and Looking Forward."

In the afternoon a forum on "Future Objectives and Planning of the Institute of Food Technologists" presided over by Professor Samuel C. Prescott, of the Massachusetts Institute of Technology, will be led by R. H. Lueck, director of research of the American Can Company, New York, and chairman of the objectives and planning committee of the institute.

An exposition will be held in connection with the meeting. Space for thirty displays has been assigned to industrial exhibitors. Educational booths will be maintained by the Chicago Section of the institute and the Quartermaster Corps Subsistence Laboratory.

THE STUDY AND TEACHING OF PHYSICAL THERAPY

THE sum of $1,100,000 has been provided by Bernard M. Baruch for a ten-year program in the study and teaching of physical therapy with special reference to the rehabilitation of wounded and ill men discharged from the Army. The funds are to be expended within the next ten years and will be distributed as follows:

Columbia University College of Physicians and Surgeons, $400,000.
New York University College of Medicine, $250,000.
Medical College of Virginia, $250,000.
Selected medical schools not yet announced, $100,000.
For fellowships and residencies. $100,000.

A committee of scientific and medical men, of which Dr. Ray Lyman Wilbur, chancellor of Stanford University, is chairman, has outlined the following plan to provide for the proper development of physical therapy: An adequate supply of physicians to teach the subject; the establishment of centers to promote scientific research on non-medical procedures, including claims that have been made by practitioners of osteopathy, chiropractic, etc.; proper usage of physical medicine in relation to war-time rehabilitation.

The grant will be administered by a board of three directed by Dr. Frank H. Krusen, professor of physical therapy at the University of Minnesota and head of the section on physical therapy of the Mayo Clinic. Dr. Wilbur will be chairman of the committee. The third member is Miss Mary Boyle, an assistant to Mr. Baruch for the last thirty-five years. Headquarters of the board will be at 597 Madison Avenue, New York City.

The grant to the College of Physicians and Surgeons of Columbia University provides for the establishment of a center for research and training, with particular reference to its application for returning veterans. New York University will establish a center for teaching and special research in the preventive and manipulative mechanics of physical medicine, and the Medical College of Virginia a center for teaching and research with particular reference to hydrology, climatology and spa therapy. The grant of $100,000 to selected medical schools is for the development of an immediate program for the physical rehabilitation of war casualties and those injured in industry. The fellowships or residencies will be for the benefit of qualified physicians who wish to receive special training in physical medicine.

The plan calls for the coordination of all work in physical therapy relating to the rehabilitation of war wounded. This will be done through the appointment by the administrative board of a special advisory committee and a second committee on war and post-war physical rehabilitation which will include representatives of the armed services, the Veterans Administration and other interested groups.

THE INSTITUTE OF BIOLOGY AND EXPERIMENTAL MEDICINE AT BUENOS AIRES

PROFESSOR BERNARDO A. HOUSSAY, the eminent Argentine physiologist whose dismissal from his professorship in the University of Buenos Aires has been discussed in recent issues of SCIENCE (98: 467, 1943; 99: 166, 176, 1944), has informed friends in this country that he has organized with private support a modest laboratory called "Instituto de Biología y Medicina Experimental," at Calle Costa Rica 4185, Buenos Aires. Associated with Professor Houssay will be Drs. E. Braun Menendez and V. G. Foglia,

who were members of his staff in the university; Juan T. Lewis, formerly professor of physiology at Rosario, and Oscar Orías, who was professor of physiology at Córdoba. As recently announced, the Rockefeller Foundation has made a grant for equipment and supplies and for stipends to several young investigators who wish to work with the group.

Because the library accumulated by Dr. Houssay through years of effort and personal expense had been given by him to the University of Buenos Aires before his separation from its faculty, the new institute is in need of reprints and other scientific literature. North American colleagues can give practical evidence of sympathy and good will for the new institution and its devoted members by sending their publications.

Referring in a recent letter to the dismissal inflicted upon him and his colleagues by the government because they signed a manifesto advocating Argentine participation in a Pan-American democratic policy, Dr. Houssay writes (translation): "All that remains to us is life, honor and dignity, the scientific vocation and love of our distracted country."

SCIENTIFIC NOTES AND NEWS

SIR RICHARD GREGORY received from the council of the British Association on his eightieth birthday a message of good wishes expressing appreciation of his service to the association.

THE Luther Gulick Award for distinguished service in physical education was presented on April 24 at the convention in New York City of the American Association for Health, Physical Education and Recreation to Dr. C. H. McCloy, research professor of anthropometry and physical education at the State University of Iowa. Dr. McCloy has been serving since January as civilian consultant to the Surgeon General of the U. S. Army. He is expected to return to the university in June.

THE annual journal award of the Motion Picture Engineers Society was presented at the recent New York meeting to William L. Bell and Ray R. Scoville, of the Bell Telephone Laboratories, for their article describing the design and use of equipment for reducing background noise in film sound-recording systems.

PROFESSOR B. J. LAMBERT, head of the department of civil engineering at the State University of Iowa, is retiring after having been connected with the university for forty-two years. A formal dinner was held on April 25, to celebrate his seventieth birthday and to announce a scholarship fund set up in his honor. He received a scroll, bearing the names of contributors to the fund, expressing appreciation of his services to the university.

BAYARD LONG, since 1914 curator of the herbarium of the Philadelphia Botanical Club, research associate of botany at the Academy of Natural Sciences of Philadelphia, was presented with a gift of books and a purse at the March meeting of the club. The presentation was made by the president of the club, Dr. Francis W. Pennell, curator of plants of the academy.

DR. ANGUS E. TAYLOR, assistant professor of mathematics at the University of California at Los Angeles, has been elected a corresponding member of the National Academy of Exact, Physical and Natural Sciences of Lima, Peru.

THE newly elected officers for the year 1944 for the Eastern Missouri Branch of the Society of American Bacteriologists are: *President,* Dr. John B. Rehm, Anheuser Busch, Inc., St. Louis; *Vice-president,* Dr. Fred W. Gallagher, department of bacteriology, St. Louis University School of Medicine; *Secretary-Treasurer,* Mary Louise Hoevel, St. Louis County Hospital, Clayton, and *Counsellor,* Dr. Philip L. Varney, department of bacteriology of the School of Medicine of Washington University.

AT a meeting on April 11 of the Wellesley College Chapter of the Society of Sigma Xi, Dr. Louise S. McDowell, professor of physics, was elected president, and Dr. Elizabeth Eiselin, instructor in geology, was elected vice-president. At this meeting, Dr. Hugh M. Raup, assistant professor of plant ecology at the Arnold Arboretum of Harvard University, gave the annual lecture. It was entitled "Botanical Exploration along the Alaska Highway."

AT the sixty-sixth annual general meeting of the Royal Institute of Chemistry held on March 15, Professor Alexander Findlay, professor of chemistry at the University of Aberdeen, was reelected to the presidency. He made the formal announcement that the style "Royal" had been added to the title of the institute. At this meeting the Sir Edward Frankland Medal and Prize for registered students of the institute was awarded to Dudley Rhoden Scarffe, of the Imperial College of Science and Technology, for his essay entitled "Introduction of the Chemist to the Public."

DR. R. G. W. NORRISH, F.R.S., professor of physical chemistry at the University of Cambridge, has been elected president of the British Association of Chemists.

DR. HUGH STOTT TAYLOR, David B. Jones professor of physical chemistry, will succeed in July, 1945, Dr. Luther P. Eisenhart as dean of the Graduate School

of Princeton University. The change, which would normally have taken place this June, has been postponed owing to the war duties of both.

COMMANDER ARTHUR S. ADAMS, U.S.N. (retired), assistant dean of the College of Engineering of Cornell University, on completion of his work with the Navy will become provost of the university.

PROFESSOR HARRY B. VAN DYKE, director of the division of pharmacology of the Squibb Institute of Medical Research, has been appointed professor of pharmacology and head of the department of Columbia University. Dr. Paul F. Kerr, professor of mineralogy, has been named executive officer of the department of geology.

DR. F. A. E. CREW, F.R.S., since 1938 Buchanan professor of animal genetics at the University of Edinburgh, has been appointed to succeed Professor P. S. Lelean as Bruce and John Usher professor of public health. Dr. Crew has had leave of absence for two years to work as director of biological research with the rank of brigadier in the medical department of the British War Office.

AT the February meeting of the Medical Fellowship Board of the National Research Council, Washington, D. C., of which Dr. Francis G. Blake, Sterling professor of medicine at Yale University, is chairman, two fellowships in the medical sciences were awarded. Three appointments, including two renewals, were made to fellowships in the filtrable viruses and orthopedic surgery. These are as follows: *Medical Sciences,* Sidney S. Sobin, Harvard Medical School, and Harry A. Wilmer, the Johns Hopkins University; *Filtrable Viruses,* Edward H. Anderson (renewal), Vanderbilt University, and I. William McLean, Jr. (renewal), Duke Hospital; *Orthopedic Surgery,* Paul S. Rubin, the Johns Hopkins University.

DR. WILBUR A. SAWYER, director of the International Health Division of the Rockefeller Foundation, has been appointed director of the Health Division of the United Nations Relief and Rehabilitation Administration.

DR. LESLIE EARLE ARNOW, head of the department of biochemical research in the division of medical research of Sharp and Dohme, Glenolden, Pa., has been appointed director of research.

F. H. FRANKLAND, since 1934 director of engineering for the American Institute of Steel Construction, has retired in order to undertake private practice as a consulting engineer.

THOMAS R. CAMP, since 1929 associate professor of sanitary engineering at the Massachusetts Institute of Technology, has resigned to open offices in the Statler Office Building, Boston, for full-time practice as a consulting engineer. He will specialize in water works, sewage works, municipal and industrial wastes, stream sanitation and flood control.

DR. ROBERT RAE, professor of agriculture at the University of Reading, England, and a member of the board of the National Institute of Research in Dairying, will succeed Professor James A. Scott Watson, who for the past two years has been agricultural attaché at the British Embassy in Washington and agricultural adviser to the High Commissioner for the United Kingdom in Canada.

DR. GEORGE K. K. LINK, professor of plant pathology at the University of Chicago, was given leave of absence for the winter quarter and is in residence at the University of Arizona, where he has guest privileges in the department of botany and the department of plant pathology. During February and March he lectured at the University of Southern California, at the University of Arizona at the Citrus Experiment Station at Riverside, at the California Institute of Technology, at Stanford University and at the University of California at Berkeley.

DR. ARTHUR MASSEY, medical officer of health of Coventry, England, has arrived in the United States as a guest of the American Public Health Association. Under the auspices of the British Information Services he will attend a series of state and regional public health meetings in the central and western states during May and June, together with a group of speakers organized to give refresher courses for two-day periods. Dr. Massey, with ten other members of the group, will appear before public health associations in Des Moines, Iowa; Minneapolis, Minn.; Chicago, Ill.; Madison, Wis.; Fargo, N. D.; Helena, Mont.; Spokane, Wash.; Moscow, Idaho; Portland, Ore.; Sacramento, Calif.; Pasadena, Calif.; Salt Lake City, Utah; Denver, Colo., and Raton, N. M., and before the health officers and public health nurses of New York State at Saratoga.

JOSEPH W. BARKER, professor of electrical engineering and dean of the faculty of engineering of Columbia University, will be the principal speaker at the ninety-fourth annual commencement on May 14 of the University of Rochester. Dean Barker has had leave of absence since 1941 to become special assistant to the U. S. Assistant Secretary of the Navy.

DR. HOWARD T. KARSNER, professor of pathology and director of the Institute of Pathology of Western Reserve University and of the University Hospitals of Cleveland, will give on May 12 at the Long Island College of Medicine, Brooklyn, N. Y., the Adam M. Miller Memorial Lecture. His subject will be the "Calcific Aortic Stenosis."

Dr. Thomas Grier Miller, professor of clinical medicine at the School of Medicine of the University of Pennsylvania, will deliver on May 26 the twentieth Lewis Linn McArthur Lecture of the Frank Billings Foundation at the Institute of Medicine of Chicago. The subject of the lecture will be "Observations on the Human Digestive Tract by Intubation."

The James Arthur Lecture on the Evolution of the Human Brain of the American Museum of Natural History will be given on May 11, at 8:15 P.M. by Professor James Howard McGregor, professor emeritus of zoology of Columbia University and research associate of the museum. His subject will be "The Brains of Primates."

An Associated Press dispatch reports that Lieutenant Commander J. W. S. Marr and a party of fourteen British scientific men are now in the Antarctic making a study of polar meteorology, radio conditions and mineral resources. The party established a base in February at Hope Bay, Grahamland, and will remain there for two years.

The twentieth annual conference and exhibit of the National Safety Council was held in Pittsburgh on April 25, 26 and 27.

A Conference on Convalescence and Rehabilitation, with Dr. Oswald R. Jones as chairman, arranged by the Committee on Public Health Relations with the aid of a grant from the Josiah Macy Jr. Foundation, was held at the New York Academy of Medicine on April 25 and 26.

The second annual meeting of the Conference on the Scientific Spirit and Democratic Faith, of which Dr. John Dewey is honorary chairman, will be held on May 27 and 28 at 2 West 64th Street, New York City.

The National Committee for Mental Hygiene has established a fund for research in psychosomatic medicine dealing with the relationship between the emotions and bodily illness. The fund begins with a nucleus of $10,000, which, it is expected, will be increased later in the light of developments and results. Dr. George S. Stevenson is the medical director of the committee under which the fund will be administered. Dr. Edward Weiss, professor of clinical medicine at the School of Medicine of Temple University, Philadelphia, has been appointed director of the fund. Members of the committee to select projects have been elected as follows: Dr. Charles M. Aldrich, head of the department of pediatric research of the Mayo Clinic, Rochester, Minn.; Dr. Franz Alexander, director of the Institute of Psychoanalysis, Chicago; Dr. Stanley Cobb, professor of neuropathology at the Harvard Medical School; Lieutenant Colonel William Menninger, head of the psychiatric division of the U. S. Army, Medical Department, Surgeon General's Office, Washington, D. C., and Dr. John Romano, professor of psychiatry at the Medical School of the University of Cincinnati.

It is reported in the daily press that Dr. Albert Ashton Berg, consulting surgeon of Mt. Sinai Hospital, New York City, president-elect of the International College of Surgeons, has given the hospital a sum of money for a modern research laboratory to be constructed after the war. The amount of the gift has not been announced, but plans for the building, to be known as the Henry W. Berg Research Laboratory, it is said, provide accommodations for research in bacteriology, pathology, physiology, chemistry, gastro-enterology, cardiology and other subjects.

The following chemicals are wanted by the National Registry of Rare Chemicals, Armour Research Foundation, 33rd, Federal and Dearborn Streets, Chicago 16, Ill.: Guanine, adenine, thymine and cytosine desoxyribosides; thymine and cytosine desoxyriboside phosphoric esters; optical fluorite—transmission limit 144 A°; sphacelenic acid; thiol carbamic acid ethyl ester (thiourethane) 10 g; thione carbamic acid ethyl ester (xanthogenamide) 10 g; dithio urethane 10 g; 1-benzyl or 1-phenyl cyclopentan-1-ol, 1-benzyl or 1-phenyl cyclopentan-1,2-diol; 1-benzyl or 1-phenyl cyclopentene-1; triamino triethyl amine β, β'-dipyridyl; sym bis acetyl acetone; triiodo acetic acid (100 grams), and isatin beta oxime.

The Royal Aeronautical Society, London, has recently received from an anonymous donor a collection of aeronautical medals, more than three hundred in number, dating from 1714 to 1941.

The report on "Industry and Research" of the Federation of British Industries has recommended the establishment of an organization whose principal object would be to stress continuously the need for industrial research and to promote and foster it in all possible ways. The form and functions of this suggested organization were discussed at a recent conference which was attended by representatives of the Royal Society, the Department of Scientific and Industrial Research, the universities and the research associations. A full discussion took place, and a subcommittee was appointed to inquire further into the subject.

The Nuffield Foundation Trustees, in development of one of the objects specified by Lord Nuffield, are undertaking a survey of the problems of aging and the care of old people. The British Ministry of Health and the Assistance Board have warmly welcomed the proposal, and will cooperate in the conduct of the survey, the object of which is to collect and collate as much information as possible with regard to the problems, individual, social and medical, associated

with aging and old age; the work being done by public authorities and voluntary organizations, and the public and private resources that exist for the care and comfort of old people in Great Britain; the provision made for old people in those countries which have given special consideration to these problems; medical research on the causes and results of aging, and on the lines on which action might usefully be taken in the future by public authorities and private organizations, including the foundation. The chairman of the survey committee is Dr. B. Seebohn Rowntree, chairman of Rowntree and Company.

DISCUSSION

IS BIOLOGY A SCIENCE?

IN "Life: Outlines of General Biology" Sir J. Arthur Thomson and Patrick Geddes say: "It is a regrettable fact that there is relatively little education in biology in the universities of the British Empire! There is abundance of first-class zoology and first-class botany, but there is relatively little general biology. No one can seriously pretend that a little zoology plus a little botany make a course of biology. One might as well say that a whiff of oxygen and a whiff of hydrogen will serve as a drink of water." These authors then tell of a student guide who was asked by a visiting professor the meaning of the word "biology" which he saw engraved over a door. After a bewildered pause the student replied: "Oh, yes! I remember now; biology is the dogfish and the bean plant."

Unfortunately general biology often is "the dogfish and the bean plant" or some other set of extractions from the biological sciences. Sometimes it is a little botany, a little zoology, a little physiology, a little anatomy, a little embryology, a little taxonomy, a little genetics, a little ecology, a little everything—a parade of discrete biological topics. If one may judge the biology course from some text-books it is an encyclopedia of biological terms, concepts and principles, which might be more conveniently arranged in alphabetical order.

Perhaps Dr. C. A. Shull, in approving of Report No. 15 of the U. S. Office of Education (SCIENCE, March 10) has been misled by courses and texts that are biology only in name. It is my opinion that Dr. Shull's anathema will not deter teachers of introductory and general courses in the biological sciences from continuing their efforts to develop biology courses which give promise of showing that biology is a science. After all, a science is a man-made category rather than an immutable compartment of knowledge imposed from above. Any science or subdivision thereof is an isolate from the totality of scientific knowledge. Under certain circumstances and for certain ends it may be convenient and appropriate to deal with a very restricted field of knowledge which can be fully and intensively explored by a specialist.

The old field of natural science has been subdivided into finer and finer categories as each former subdivision becomes too unwieldy to comprehend intensively. With no intention of decrying this tendency, which has been necessary to the expansion of knowledge and without which our conquest of the unknown would be impossible, I wish to suggest that other circumstances and other purposes demand broader and less penetrating viewpoints. I refer to present circumstances and to the purposes of general education. The present circumstances are the conditions of the democratic society in which we live and which we hope to improve; chief among the purposes of general education, I believe, is the preparation of an intelligent citizenry for the responsibilities of citizenship in our democracy. In this preparation the biological sciences must be recognized as essential to the understanding of the responsibilities, both personal and social, of the citizen. Good health, adequate growth and development, nutrition, food production, reproduction, heredity and environment, and the conservation of natural resources for use and for recreation are some of the topics appropriate to general education. These are biological rather than zoological or botanical topics, for they require fundamental knowledge drawn from both plant and animal kingdoms.

The more specialized a course is, the more difficult it becomes to select facts and principles which are most pertinent to the objectives of general education and to eliminate those of academic interest and those which have exaggerated significance in the minds of specialists who are unable to appreciate other objectives than their own. Biology, because it is more generalized than botany and zoology, thus lends itself better to general education than these specialized courses.

Furthermore, from a pedagogical standpoint, there is much to be gained in understanding and appreciation by the student if the living world is synthetically rather than analytically treated. Through common physiological phenomena and especially through ecological connections plants and animals, not excluding man, are bound in one great unit. Animals can not be thoroughly understood or appreciated without knowledge of plants; neither can plants be isolated from animals without losing much that is essential to a knowledge of their place in the world of man.

Because most of us have been trained as specialists it is easy for us to lose sight of the broader aspects of

the living world. Because biological knowledge was delivered to us in tight compartments, it is very difficult to reconstruct a unified science of biology. But such a science is possible and such a science, perhaps far from the perfection we desire, is being taught by many former zoologists and botanists who are becoming biologists. The process is not easy. It requires a thorough reeducation of the teacher. It may require new knowledge from unfamiliar fields; it demands a reassessment of values appropriate to new objectives; it means the discarding of some cherished "fundamentals" and the adoption of new ones; it may call for a rearrangement of topics and materials; and it may well suggest the exploration of new methods and techniques.

Admitting that some of the courses in general biology have been, as Dr. Shull declares, "a fraud against the student" and that many are not well unified, which are criticisms that might reasonably be directed towards other subjects, I am not ready to accept the dictum of Dr. Shull that biology is non-existent nor the pronouncements of others with whom biology is in disfavor. I think it will be found that courses in botany and zoology, on which Dr. Shull places his *nihil obstat*, are frequently no more unified than the worst of the biology courses.

It is true that the "existence of the word 'biology' does not mean that there is a well-unified science which can be so designated," but my own experience and that of others leave me with a strong conviction that much progress has been made towards unification and that " a better day will dawn" for the teaching of biological science as a result of the continued efforts of the general biologists to construct a unified course in biology.

As scientists, however, we should not be content to judge the merits of biology solely on the basis of opinions, pro and con. The opposing groups may have quite different objectives in mind, and we must first decide what we expect to accomplish by teaching the biological sciences. What I have in mind may differ from the ideas of other proponents of general biology. Even if we can agree on general objectives, it should be patent that subjective opinion for or against biology is not a sound basis for a final decision. Both hypotheses can and must be tested by properly planned and conducted educational experimentation before we can know whether we are accomplishing what we desire.

If I may be permitted to add a personal note, I should like to explain that I embarked unwillingly on the teaching of biology with ideas that were quite in agreement with those of Dr. Shull. In spite of early antagonisms which had been strongly conditioned as a result of my own specialized training, I have come to an entirely opposite opinion and a firm conviction that general biology courses merit the continued support of their adherents and greater tolerance on the part of those who oppose them.

LELAND H. TAYLOR

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"HORSE SERUM" A COMPOUND WORD

THE discussion of "horse serum" has already reached considerable length, but it may be permissible to make one more point—namely, that every one concerned has misinterpreted the nature of the disputed phrase. It is not a case of one noun being used as an adjective to modify another; it is a compound noun, exactly analogous to such Greek compounds as thermometer. The first member takes the place, not of an adjective, but of a phrase. "Horse serum" is serum from a horse; "fence post" is post of a fence; "rat poison" is poison for rats. Thermometer, if its first member were adjectival, would mean a "hot meter," not a measure of heat. In most such cases, the compound has a special and definite meaning, not conveyed by an adjective and noun. Had this been understood, neither the original editorial faux pas nor the resultant burst of argument need ha.e occurred. The author (or, if he forgot it, the editor) would merely have inserted a hyphen between "horse" and "serum" and all would have been well.

That the situation was not understood is partly because, though the use of compounds in place of prepositional or other phrases in English has increased in recent years by leaps and bounds, we have not yet developed a consistent or in any way adequate orthography for indicating them. This is admirably illustrated by the playful contributor who wrote "horse sense" and "horse-laugh" in the same sentence. The makers of the Century Dictionary perceived the usefulness of the hyphen as an indicator, but few have followed them. So long as we offend the verities by writing compounds as separate words—which they are not—we shall have confusion and wrangles like the present.

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CONCERNING THE RATE OF EVAPORATION OF WATER THROUGH ORIENTED MONOLAYERS ON WATER

I HAVE read with the greatest interest the monograph on "Surface Chemistry" just published by the American Association for the Advancement of Science. The excellent foreword by Dr. Moulton, emphasizing the importance of this new branch of science, reminded me of the man who, I think, can rightly be considered as the founder of this science, my old and

esteemed friend, Professor Henry Devaux, of Bordeaux (France), who was the first to demonstrate clearly the existence of monomolecular layers at the surface of water. Dr. Langmuir, in his fundamental paper,[1] gave him full credit for this pioneer work, and described his experiments as "beautiful in their simplicity."

Professor Devaux, who is very old now, was still working on monolayers, under particularly difficult conditions, when I left France in August, 1942.

I should also like to mention the fact that, to my knowledge, I published the first paper on the influence, on the rate of evaporation of water, of a monolayer of oriented molecules. This paper undoubtedly escaped the attention of Dr. Langmuir, as it was printed in the *Journal of Experimental Medicine*[2] under the misleading title, "Further evidence indicating the existence of a superficial polarized layer of molecules at certain dilutions" (solutions of serum).

I reported a definite slowing up of the rate of evaporation, but my method was crude in comparison with that employed by Drs. Langmuir and Schaefer.

P. LECOMTE DU NOUY

SCIENTIFIC BOOKS

BOTANICAL BOOKS

The Succulent Euphorbieae (Southern Africa). By ALAIN WHITE, R. ALLEN DYER and BOYD L. SLOANE. 2 vols. xv + 990 + 11 + 11 pp. 1,102 figs. + 25 plates. Pasadena, Calif.: Abbey Garden Press. 1941. $12.00.

EVERY scholar has a dream of books that he would like to write if the fates but smiled. The authors of "The Succulent Euphorbieae" may be congratulated, not merely on the broad vision of their undertaking, but also on the splendid way in which their dream has been realized.

In the introduction we are told that the family Euphorbiaceae includes more than 250 genera and 6,000 species; this family is divided into a number of tribes, of which the largest is the Euphorbieae, "and it is with a part of this tribe alone that the present book deals." The largest genus of the tribe by far is *Euphorbia,* and this, *Monadenium* and *Synadenium* are the three genera considered in the present work, which is restricted to "what may somewhat indefinitely be called the succulent Euphorbias of southern Africa."

The introduction is devoted partly to a discussion of the peculiar inflorescence of this group—the cyathium—and to a consideration of the pistillate and staminate flowers of which it is constituted. The vegetative characters, with their great multiplicity of form, are next taken up, and their striking similarity in many cases to the Cacti, to which they are entirely unrelated, either phylogenetically or geographically, is pointed out; in spite of the vegetative variability, the relatively uniform structure of the cyathium has been maintained. The last part of the introduction is devoted to a historical discussion of the group.

There are keys to the above-mentioned three genera, and then to 193 species of the genus *Euphorbia*. Each of these species is subsequently taken up in very considerable detail, with complete descriptions of the plant, the spines, the leaves, the inflorescence and the capsules. Next follow type locality and distribution. After these formal accounts, in each case there is a discussion of history, relationships, growth habits, geographical occurrence, etc. These informal presentations are prepared in delightful style and give the volumes life and charm. Two species of *Monadenium* and two of *Synadenium* are similarly considered.

The first Appendix, A, lists the new species, varieties and combinations proposed in the book and gives Latin descriptions when necessary. In all, thirteen new species, fifteen new varieties, seven new combinations and one change of name are offered. A glossary, bibliography, discussion of five undetermined species and "Notes on Euphorbia Culture" conclude these volumes.

One of the most striking features of this work is the illustrations. In all, one hundred and ninety-seven species are described, and there are more than eleven hundred figures, including seventy in the introduction. Most of the species, therefore, are illustrated by a number of figures. In addition, there are twenty-five plates in full color.

Even if you are among the uninitiated, you can turn through these pages and gain a conception of what this group is like from the illustrations. And if you do, you will read some of the accounts, and you will be impressed by the polish, and in some instances by the quaintness, with which they are presented.

"The Succulent Euphorbieae" is a monument, of which the authors may well be proud.

The Carnivorous Plants. By FRANCIS ERNEST LLOYD. xvi + 352 pp. 11 figs. + 38 plates. Waltham, Mass.: Chronica Botanica Company. 1942. $6.00.

ALTHOUGH other accounts of carnivorous and in-

[1] *Jour. Am. Chem. Soc.*, 39: 1848, 1917.

[2] Vol. 39, p. 717, 1924.

sectivorous plants have been written, the lack of a recent and comprehensive treatment of these plants would in itself make the present volume worth while. When to this is added the intensive research of the author for more than a decade, "The Carnivorous Plants" becomes an especially valuable book. Professor Lloyd states in the preface that his interest in these plants began with work on *Utricularia gibba*, but that the treatise under consideration is based on material collected and received from many sources.

There is one relatively short chapter on carnivorous fungi, in which we read of "loop snares," "eel-bob snares" and "adhesive organs." Each of the other thirteen chapters deals with one or more of the fifteen angiospermous genera that stoop to conquer flesh—often, though by no means always, that of insects These fifteen genera, which occur in six different families, include some 450 species, of which, however, *Utricularia* has 275, *Drosera* 90 and *Nepenthes* 65. Five of the genera are monotypic.

The kinds of traps, in addition to the snares of the fungi, are classified as "pitfalls" (pitcher plants) as in *Sarracenia, Darlingtonia, Nepenthes*, etc., "lobster pot" as in *Genlisea*, "bird lime or fly-paper traps"—passive as in *Byblis* and *Drosophyllum*, active as in *Pinguicula* and *Drosera*, "steel-trap" as in *Dionaea* and *Aldrovanda*, and "mousetrap" as in *Utricularia*, etc. Lures are also present, which may take the form of odors in *Sarracenia* and *Drosophyllum*, nectar secretion in *Nepenthes*, attractive colors in *Sarracenia* and *Darlingtonia* and of brilliant points of reflected light in *Pinguicula* and *Drosera*.

Each of the chapters is really an intensive study of the structure, development, mechanisms and interpretations of the various genera. The treatment accorded to *Drosera* and *Utricularia* is especially inclusive, a separate chapter of thirty-eight pages being devoted to the *Utricularia* trap. The literature cited at the end of each chapter is extensive; this indicates the interest that these plants have aroused for a very long time and testifies to the assiduity of the author. In addition to eleven text figures, there are thirty-eight plates, each with numerous illustrations.

Every one who reads about these plants wants to know whether their carnivorous habits really benefit them. This topic is discussed in detail in the chapter on *Drosera*, and abundant evidence for the affirmative conclusion is assembled. In the introduction also this subject is considered. "From the purely physiological point of view the carnivorous plants are concerned in a somewhat special way in the acquisition of nutrient substances containing protein, possibly vitamins and perhaps the salts of potassium and phosphorus, and even others. In this way they receive some profit, though what they receive is no *sine qua non*, as it is with many other plants."

Professor Lloyd has written a scholarly, complete, authoritative volume—one that will take its place fittingly on the library shelf beside Charles Darwin's "Insectivorous Plants," published in 1873. The author writes with clarity, with conviction and on occasion with a touch of humor. And if, at times, his presentation seems intricate and involved, as in the *Utricularia* trap, so is the subject.

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REPORTS

MEDAL DAY AT THE FRANKLIN INSTITUTE

AN American and a Russian scientist share the highest honors of The Franklin Institute this year. The selection of Dr. William David Coolidge, vice-president and director of research for the General Electric Company; and Dr. Peter Kapitza, director of the Institute for Physical Problems, Academy of Sciences, Union of Soviet Socialist Republics, to receive the Franklin Medal was based upon work in physical science or technology, without regard to country, which in the opinion of the institute, acting through its Committee on science and arts, has done most to advance a knowledge of physical science or its applications.

Dr. Coolidge received the Franklin Medal "in recognition of his scientific discoveries, which have profoundly affected the welfare of humanity, especially in the field of the manufacture of ductile tungsten and in the field of improved apparatus for the production and control of x-rays"; and Dr. Kapitza "in recognition of his remarkable contributions to experimental physics and also to theoretical physics, especially in the fields of magnetism and low temperatures."

Since the founding of the Franklin Gold Medal in 1914, the face of which carries a medallion of Benjamin Franklin done from the Thomas Sully portrait of Franklin owned by The Franklin Institute, it has been awarded by the institute to such figures as Thomas A. Edison, Guglielmo Marconi, Charles Fabry, Pieter Zeeman, James H. Jeans, Orville Wright, Albert Einstein and Charles F. Kettering.

Dr. Coolidge has won many scientific awards, among them the Howard N. Potts and the Louis Edward Levy Medals of The Franklin Institute, and an honorary M.D. degree from the University of Zurich. Interested in mechanical problems and principles since his

youth on a farm in Hudson, Mass., Coolidge won a scholarship to the Massachusetts Institute of Technology in 1895. Upon graduating from that institution he continued his studies abroad and in 1899 was awarded his Ph.D. at the University of Leipzig. After six years of research work and teaching he accepted a research position in the physical chemistry laboratories of the General Electric Company.

His x-ray tube has changed x-ray technique from an art to a science, enormously extending the range, utility and effectiveness of x-rays. In developing the x-ray tube from an inexact device to its present form —a tube with the highest possible vacum in which an electron stream from a filament, heated by an auxiliary current, can be directed upon a tungsten target by a separately controlled voltage—he has completely revolutionized the use of x-rays, creating the science of radiology. He has developed the tube to a point where it can operate on much higher voltages. The greater penetrating power which results is now used in cancer research. In achieving this, Coolidge applied the cascade principle, which is now used in equipment for radiographic examination of steel castings and welds, to discover internal defects.

The modern incandescent lamp, because of Coolidge's development of the drawn tungsten filament and Langmuir's contribution of filling the lamp with gas, has saved our country over a billion dollars a year in lighting bills. Tungsten, always a brittle metal because of its crystalline structure, became both ductile and fibrous as a result of Coolidge's researches and tireless effort.

From his home in Schenectady, N. Y., Coolidge sent a daughter to study and then teach biology; she later married a biologist. His son is studying economics at Columbia University. Hobbies interesting Dr. Coolidge are color photography, both still and motion picture, and astronomy. Impatient of carelessness or superficiality because of his own perceptive qualities of mind which go quickly to essential and crucial facts, he nevertheless possesses a keen sense of humor. It is understandable to consider Coolidge the 1940 selection of the National Association of Manufacturers as one of the "Modern Pioneers," and a winner of the Duddell Medal of the Physical Society of London. He is a member of many scientific societies and organizations.

Peter Kapitza, the son of the late General Leonid Kapitza of the Russian Imperial Army, was born at Kronstadt, Russia, in June, 1894. Electrical engineering training at Petrograd Polytechnical Institute was followed by further study at Cambridge University, England. From 1924 until 1932 Kapitza was assistant director of magnetic research at the Cavendish Laboratory, Cambridge, England. He held the Royal Society Messel research professorship as well as being director of the Royal Society Mond Laboratory for research at low temperatures. The Franklin Institute awarded him a Franklin Medal in 1944 " in recognition of his remarkable contributions to experimental physics and also to theoretical physics, especially in the fields of magnetism and low temperatures."

Dr. Kapitza's great work has been the invention of a method of producing extraordinarily high magnetic fields, many times greater than were previously thought possible, and the development of ingenious methods for making magnetic measurements of various kinds upon small pieces of matter exposed for a small fraction of a second to such fields. The results obtained provide important information about the structure and the behavior of the atoms of ferromagnetic, paramagnetic and diamagnetic substances.

He also designed and constructed a machine for making liquid air and liquid hydrogen which is much more efficient and smaller than any machine yet developed. It is believed that the Russian Army has used liquid air and applications of Kapitza's researches for military purposes.

Other prominent men in scientific and industrial fields who received medals at The Franklin Institute Medal Day ceremonies include Dr. Roger Adams, head of the department of chemistry (now on leave), University of Illinois, Urbana, Illinois. Dr. Adams received the Elliott Cresson Medal award for his notable work in organic chemistry.

The John Price Wetherill Medal was awarded, posthumously, to Richard C. duPont, president, All American Aviation, Inc., Wilmington, Del., "for his development of a successful and practical 'on the wing' air mail and glider pick-up apparatus"; and to Willem Fredrik Westendorp, Research Laboratory, General Electric Company, Schenectady, N. Y., "for his development of a successful high-voltage, low-frequency resonance transformer of relatively small size and light weight, which is shock-proof, efficient in operation and particularly suitable for use in high voltage portable x-ray units."

Two Philadelphians, Frank B. Allen and J. Stogdell Stokes, of the Allen-Sherman-Hoff and Stokes-and Smith companies, respectively, were awarded the Edward Longstreth Medal, Allen, for the development of the hydroseal pump, and Stokes for developing new machinery used in making paper boxes. Edward E. Simmons, Jr., of Sacramento, Calif., was awarded the Edward Longstreth Medal for his invention of the SR-4 Strain Gage, now in wide industrial use.

The Frank P. Brown Medal was awarded to Dr. Harvey Clayton Rentschler, director of research, Lamp Division, Westinghouse Electric and Manufacturing Company, Bloomfield, N. J., "in consideration of his application of a source of bactericidal radiation

in air conditioning systems in a scientific and practical manner."

Dr. Walther Emil Ludwig Mathesius, president and director of the Geneva Steel Company, Geneva, Utah, received the Francis J. Clamer Medal for outstanding achievements in the field of metallurgy, particularly for contributions in blast furnace practice.

The George R. Henderson Medal was awarded to Joseph Burroughs Ennis, senior vice-president, American Locomotive Company, New York, "in consideration of his accomplishments in locomotive engineering and important contributions in the field of locomotive design."

For his paper on "The Theory of Suspension Bridges," which appeared in the March and April, 1943, issues of the *Journal of the Franklin Institute,* Professor Stephen P. Timoshenko, department of theoretical and applied mechanics, Stanford University, Palo Alto, Calif., was awarded the Louis E. Levy Medal.

A Certificate of Merit was given to the Western Union Telegraph Company, New York, "for the development of the reperforator switching system, a contribution to the greater accuracy and speed of telegraphic service."

HENRY BUTLER ALLEN,
Secretary and Director, the Franklin Institute

SPECIAL ARTICLES

THE INFLUENCE OF IRON OXIDE ON WEAR OF RUBBING SURFACES

In the course of an investigation of wear under boundary lubrication the condition was produced which permits hard and soft ferrous surfaces to rub under very heavy loads at a moderate speed without rapid wear despite the absence of special wear-inhibitors in the hydrocarbon lubricant. The tenacious layers of iron-oxide which slowly develop under the lubricant and cover the rubbing surfaces were studied with the aid of a microscope and their ability to reduce wear was related to the hardness or imbedability of the surfaces. The following summarizes some of the experiments:

In the first experiments a modified Timken machine[1] was used, in which a stationary block of mild steel or of cast-iron, with a wearing face measuring one by ten millimeters was aligned with its longer edge perpendicular to the direction of rotation of a polished hard steel cylindrical ring measuring five centimeters in diameter by ten millimeters wide. The ring was turned upon its axis with a peripheral speed of 209 centimeters per second while pressure was applied to the block and a plentiful supply of lubricant flowed over both parts.

Failure due to the adhesion and transfer of metal from the block to the ring by welding would occur instantly unless the apparent bearing pressure was very light (20 to 30 kg/cm^2). If the initial pressure was gradually increased from this low figure, a worn-in state could be developed, in the course of several days, whereby a pressure of 2 or 3 thousand kilograms per square centimeter could be borne without failure. Wear-in or break-in was materially assisted by frequently repolishing the ring to remove particles of metal which had been transferred to it. No attempt was made to polish the block. After the break-in process was complete, welding ceased and further polishing was not necessary.

The rate of wear of a properly broken-in mild-steel or cast-iron block was so low that no loss of weight could be detected by reweighing the block to 0.2 mg after a day or two of high-pressure operation (2,000 to 3,000 kg/cm^2). In some experiments a slight gain in weight of both the ring and the block was noticed after prolonged operation; this is attributed to the accumulation of iron-oxide.

In further experiments similar attempts to break-in hard steel blocks were unsuccessful; failure occurred from seizure at pressures below 800 kg/cm^2.

Observations of a similar type were made during experiments with the four-ball wear machine, an adaptation of Boerlage's apparatus.[2] In this machine, three stationary balls of hard steel, of cast iron or of mild-steel clamped in a cup and covered with the lubricant, were pressed upward with a measured force against a hard steel ball spinning on a vertical axis. When heavy loads (60 kg or more) were applied, there was an immediate transfer of metal to the spinning ball, and rapid wear of the stationary balls occurred when an ordinary mineral oil was the lubricant at these loads. However, with a very light load (7 kg), no welding was observed; the sliding action appeared to be smooth, and the wear occurring could be determined by measuring scar diameters at predetermined intervals of time. Such measurements are given in Table 1.

During the break-in period the contact areas of the soft stationary balls rapidly expanded, probably by plastic flow, until the contact pressures reached the approximate range of 2,000 to 3,000 kg/cm^2, depending upon temperature. However, the scars in the more elastic stationary balls did not expand so rapidly

[1] Timken Roller Bearing Company, Canton, Ohio.

[2] *Engineering*, 136: 46, 1933; 144: 1, 1937.

at first, but wore continuously until at length they had become much larger, and the pressures much smaller than in the softer balls.

The red and brown material reported in the table has been identified as iron-oxide produced in the wearing areas by friction-oxidation. Microscopic observation revealed that the oxide became imbedded in the softer metals but not in hard steel. Well-established iron-oxide deposits were also observed on the broken-in mild-steel and cast-iron wear blocks of the Timken machine, but not on the hard steel blocks which failed to break-in. The observations indicate that the presence of these oxide layers on soft metal balls must have contributed materially to the low rate of wear after break-in, and the absence of oxide from hard steel balls permitted continuous wear without the occurrence of break-in.

It is apparent from the work of Bowden, Hughes and Whittingham[3] that fresh ferrous surfaces operate in danger of seizure owing to the high coefficient of boundary friction; such seizure results in the establishment of metal bridges which have the shear strength of the metal involved. On the other hand, if a contaminating film of oxide, sulfide, halide, etc., exists, shearing occurs along the plane of the mechanically weaker contaminant and friction is reduced.

The experiments of Bowden and Tabor[4] indicate that the area of intimate contact of lightly loaded sliding surfaces is very small, and at local areas the pressure may exceed the elastic limit and cause steel to flow plastically. It would seem, therefore, that despite the light initial load, local conditions in the Timken machine were essentially the same as in the four-ball machine where the calculated initial contact pressure at 7 kg load approached the elastic limit of the hard, and far exceeded that of the soft steel balls.

TABLE 1

THE RELATIVE RATES OF WEAR OF HARD AND SOFT STATIONARY BALLS IN THE FOUR-BALL WEAR MACHINE

Conditions: Speed, 700 rpm (31 cm/sec); load, 7 kg; lubricant, SAE 20 motor oil, air saturated; rotating ball of hard steel, stationary balls as listed.

Elapsed minutes operation	Mild steel stationary balls (200 Brinell)			Cast-iron stationary balls (230 Brinell)			Hard steel (SKF) stationary balls (630 Brinell)		
	Average diameter of six scars, mm	Scar pressure kg/cm²	Appearance of scars*	Average diameter of six scars, mm	Scar pressure kg/cm²	Appearance of scars*	Average diameter of six scars, mm	Scar pressure kg/cm²	Appearance of scars*
				Lubricant Temperature, 30° C					
5	.316	3,640	Reddish brown	.282	4,580	Reddish-brown	.214	7,950	Polished steel
10	.336	3,220	"	.292	4,270	"	.225	7,190	"
20	.349	2,990	"	.310	3,790	"	.254	5,640	"
40	.340	3,150	Brown	.322	3,510	"	.272	4,920	"
80	.344	3,250	"	.342	3,110	"	.347	3,020	"
160	.340	3,150	Dark brown	.345	3,060	"	.431	1,960	"
320	.341	3,130	"	340	3,150	"	437	1,910	Slightly reddish
640	.373	2,620	"	390	2,390	"	.438	1,900	Reddish-brown
				Lubricant Temperature, 130° C.					
5	.490	1,460	Reddish-brown	.413	2,130	Reddish-brown	.332	3,300	Polished steel
10	.518	1,360	"	425	2,010	"	.395	2,330	"
20	.525	1,320	"	.434	1,930	"	.486	1,540	"
40	.528	1,310	"	.450	1,800	"	.601	1,010	"
80	.547	1,220	"	484	1,550	"	.701	741	"
160	.598	1,020	"	.544	1,230	"	.763	625	"
320	.633	908	"	.565	1,140	"	.893	456	"
640	.645	875	"	.584	1,070	"	1 04	336	"

* Dark field illumination at 30 or 60 diameters.

The mechanism controlling the surface events which determine whether a new bearing shall fail or shall become broken-in to carry heavy loads is visualized as follows: At low initial loads where the destruction of the bearing surface by seizure can be avoided, the heat of mild rubbing accelerates the oxidation of iron in the surface by oxygen dissolved in the lubricant. If the surface is imbedable, the resulting oxide becomes established as a protective layer in much the same way as reported by Eichinger for unlubricated surfaces.[5] Rubbing now occurs over the oxide layer and the ferrous surface beneath is thus prevented from having direct contact with oxygen activated by rubbing. Hence further friction-oxidation decreases to the vanishing point.

Hard steel surfaces, not being receptive to foreign materials, remain bare during rubbing and subject to attack by oxygen, leading to continuous removal of metal or wear. On the other hand, the softer metals

[3] Bowden and Hughes, *Proc. Roy. Soc.*, A-172: p. 263, 1939. Hughes and Whittingham, *Trans. Faraday Soc.*, 38: p. 9-27, 1942.

[4] Bowden and Tabor, *Proc. Roy. Soc.*, A-169: 391-413, 1938.

[5] Eichinger, Eidgenöss. Materialprufüngs-u. Versuchsanstalt Ind., Bauw. Gewerbe, Zurich Diskussionsber No. 121, 32 pp., 1938.

become coated and resistant to further wear, as the data illustrate.

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ISOLATION OF A NEW LACTOBACILLUS CASEI FACTOR

SNELL and Peterson[1] first presented evidence for the existence of a new growth factor (the "norite eluate" factor) for *Lactobacillus casei*. Mitchell, Snell and Williams[2] reported the concentration of a factor ("folic acid") from spinach. This factor was active for both *Streptococcus lactis* R and for *L. casei* Hutchings, Bohonos and Peterson[3] showed that purified concentrates of the "norite eluate" factor from liver stimulated the growth of *Lactobacillus helveticus*, *Lactobacillus delbruckii*, *Propionibacterium pentosaceum* and *Streptococcus lactis* R.

Since then a number of different compounds have been described which are active in stimulating the growth of *L. casei* or *S. lactis* R. Pfiffner[4] *et al.* reported the isolation from liver of a crystalline compound which was active for *L. casei*. This substance which they designated vitamin B_c was also active in preventing anemia and in promoting growth in chicks. Stokstad[5] described two compounds; one was obtained from liver and the other from yeast. That obtained from liver was thought to be identical with the compound obtained by Pfiffner *et al.* The free acids of the compounds obtained from liver and yeast had equal potency for *L. casei*. However, when assayed with *S. lactis* R the preparation from yeast was only half as active as from liver. Both the factors from liver and yeast appear to be different from the growth factor for *S. lactis* R described by Keresztesy *et al.*[6] Their preparation was approximately 2,500 times as active for *S. lactis* R as for *L. casei*.

In this communication we wish to report the isolation in crystalline form of a new compound which is active for *L. casei* and *S. lactis* R and is also active in the nutrition of the chick. This new compound was crystallized as the barium salt, as the free acid and as the methyl ester. The barium salt crystallized as needles, the free acid and the ester crystallized as small needles or threads. The absorption spectrum in 0.1 N NaOH was very similar to the compound isolated from liver (Table 1). It will be noted that the $E_{1\,cm}^{1\,per\,cent}$ was less for the new compound, being only 86 per cent. as great at 365 mμ.

TABLE 1
COMPARISON OF ABSORPTION SPECTRA

	New compound		Liver compound		Ratio $\frac{\text{New compound}}{\text{Liver compound}}$
	mμ	$E_{1\,cm}^{1\,per\,cent}$	mμ	$E_{1\,cm}^{1\,per\,cent}$	$\frac{E_{1\,cm}^{1\,per\,cent}}{E_{1\,cm}^{1\,per\,cent}}$
Maxima ...	259	317	255	440	0.72
Minima ...	266	305	267	376	0.81
Maxima ...	280	333	283	425	0.78
Minima ...	332	92	331	103	0.89
Maxima ...	365	130	365	151	0.86

This new compound was 85 to 90 per cent. as active as that from liver when assayed with *L. casei*, but only 6 per cent. as active as the liver compound by *S. lactis* R assay. The amounts of the liver compound required for half-maximum growth were 0.000055 micrograms per ml for *L. casei* and 0.00025 micrograms per ml for *S. lactis* R. The new compound was required in amounts of 0.000061 micrograms per ml for *L. casei* and 0.0042 micrograms per ml for *S. lactis* R.

On the basis of their absorption spectra the three *L. casei* factors (present compound, liver and yeast factors) appear to be different from "folic acid." The $E_{1\,cm}^{1\,per\,cent.}$ for this new compound and the liver *L. casei* factor were determined at pH 11.0 and compared with the data at the same pH reported by Mitchell[7] (Table 2). The wave-lengths chosen do not represent maxima or minima but were used to correspond with the wave-lengths reported for folic acid.

TABLE 2
COMPARISON OF $E_{1\,cm}^{1\,per\,cent}$ AT PH 11.0 OF THE L. CASEI FACTORS AND FOLIC ACID

	New compound	Liver compound	Folic acid
mμ	$E_{1\,cm}^{1\,per\,cent}$	$E_{1\,cm}^{1\,per\,cent}$	$E_{1\,cm}^{1\,per\,cent}$
260	296	404	338
280	336	410	190
300	245	334	102
380	121	125	92

B. L. HUTCHINGS
E. L. R. STOKSTAD
N. BOHONOS
N. H. SLOBODKIN

LEDERLE LABORATORIES, INC.,
PEARL RIVER, N. Y.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A CHEMICALLY DEFINED MEDIUM FOR THE CULTIVATION OF THE GONOCOCCUS[1]

A FLUID medium comprising 9 organic acids, 5 inorganic salts and glucose has been developed for the growth of the gonococcus. It contains 7 organic acids in addition to those required by the meningococcus as reported by Frantz.[2] The composition is as follows:

	Grams per liter
d-Glutamic acid[3]	1.3
dl-Leucine[3]	0.40
l-Arginine monohydrochloride[3]	0.25
l-Histidine monohydrochloride[3]	0.15
dl-Methionine[3]	0.15
l-Proline[3]	0.10
Glycine[4]	0.05
l-Cystine[4]	0.01
Indole-3-acetic acid[4]	0.10
NaCl[5]	6.0
$NaH_2PO_4 \cdot H_2O$[5]	2.5
NH_4Cl[5]	1.25
$Mg(NO_3)_2 \cdot 6H_2O$[5]	0.05
$FeSO_4$[5]	0.012
Glucose[4]	5.0

With the exception of glucose, indole acetic acid, ferrous sulfate and magnesium nitrate, the constituents are added to 950 ml of distilled water. The pH of the mixture is adjusted with normal sodium hydroxide to from 6.8 to 7.0, and then autoclaved at 121° C for 10 minutes in a pyrex-glass container. After cooling to room temperature, 25 ml of a sterile 20-per cent. glucose solution are introduced into the medium. One per cent. solutions of ferrous sulfate, magnesium nitrate and indole acetic acid are added separately in the following volumes, respectively; 1.2 ml, 5.0 ml and 10.0 ml. The pH is finally readjusted to from 7.0 to 7.2.

Five ml of the medium were inoculated with one loopful of washed gonococcal cells obtained by centrifugation from a 24-hour Douglas's broth culture. Incubation was carried out at 37° C in an atmosphere containing approximately 10 per cent. of carbon dioxide. The method of introducing 10 per cent. tank carbon dioxide as described by Leahy and Carpenter[6] gave better results than the method of burning a candle to self-extinction. The gaseous mixture was replaced at daily intervals.

Sixty strains of *Neisseria gonorrhoeae* were employed for the development and testing of this medium. Both recently isolated strains and those subcultured for several years were included. Not all strains grew equally well and approximately 25 per cent. did not grow either in the synthetic medium or in Douglas's broth. Growth was maximal after 2- to 3-days' incubation. At this time, 5.0 ml of the medium contained, on the average, 0.25 mg of bacterial nitrogen, which is equivalent to 2.0 mg of gonococcal cells. The growth was more than double that obtained in Douglas's broth under the same conditions. The cells remained viable for at least 5 days. Cultures transferred every third day have been maintained readily for 3 months.

The final concentration of each substance in the medium was determined on the basis of maximal growth of the majority of the strains tested. The concentrations of glycine, cystine, ferrous sulfate and of both ions of magnesium nitrate were critical. The amount of the other substances employed in the medium permitted of some variation. Divalent lead and trivalent iron salts in concentrations of 10 micrograms per ml favored the growth of certain strains. The manganous ion, in a concentration of 5 micrograms per ml was toxic for the gonococcus. The cupric ion was also toxic but only at concentrations greater than 5 micrograms per ml.

Growth of the strains which otherwise failed to grow in the medium above described was obtained in almost every instance when glutamine[7] and choline were incorporated in the medium in concentrations of 0.2 mg and 0.1 mg per ml, respectively.

Studies to determine the more rigid requirements of certain primary cultures of *Neisseria gonorrhoeae* are in progress.

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[1] Supported in part by grants from the John and Mary R. Markle Foundation and the United States Public Health Service.

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BOOKS RECEIVED

DOBZHANSKY, TH. and CARL EPLING. *Contributions to the Genetics, Taxonomy and Ecology of Drosophila pseudoobscura and Its Relatives.* Illustrated. Pp. iii + 183. Carnegie Institution of Washington.

GUSTAFSON, A. F., C. H. GUISE, W. J. HAMILTON, JR. and H. RIES. *Conservation in the United States.* Illustrated. Pp. xi + 477. Comstock Publishing Company. $4.00.

STEWART, JOHN Q. and NEWTON L. PIERCE. *Marine and Air Navigation.* Illustrated. Pp. xii + 471. Ginn and Company. $4.50.

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ANTHROPOLOGY'S CONTRIBUTION TO INTERRACIAL UNDERSTANDING[1]

By Dr. HARRY L. SHAPIRO
AMERICAN MUSEUM OF NATURAL HISTORY

THERE still exists in our industrial societies a tendency, inherited from the past, to regard technological progress as wholly beneficent. We have become accustomed to hail enthusiastically every advance for its own sake or for the greater ease it brings into our personal lives, without consideration for its effect upon our society. We have grasped eagerly at the fruits of science regardless of their price. Now we are discovering that they have a price; that every advance of technology enhances our responsibilities whether we like it or not. The radio, the movie, the airplane have, or should have, taught us that technology may be beneficent, but may also serve evil purposes; that the acceptance of these productions can not remain superficial but must enter into and profoundly alter the organization of our societies.

[1] Address delivered at the Cranbrook Institute of Science on the opening of an exhibit on the races of man, January 21, 1944.

In no aspect of our lives as members of a complex industrial community, or as a nation in the modern world, has technology brought greater responsibilities than in our attitudes toward the various groups that make up our society, or toward the peoples that constitute mankind. It is a commonly observed truism that the world grows more interdependent, and that our society demands increased cooperation from all its members, as mechanization progresses. As for the future that lies ahead who can question that this process with its demands will continue? There is, therefore, every reason to believe that more cooperation rather than less will be required of us, if the structure of our society is to be preserved. Indeed, the very war in which we are now engaged may be said to be the result of an effort to substitute coercion, intolerance and slavery for our traditional ideals of cooperation.

The evidences of intolerance and of lack of cooperation which confront us on all sides represent maladjustments which become increasingly portentous as the needs for tolerance and cooperation become more pressing. There can, I think, be no question that one of the gravest problems facing our internal as well as our external existence lies in our ability to compose the differences that exist and to create understanding in their place. This is particularly true of the United States, where, unfortunately, the materials for group antagonisms are all too abundant. Although essentially the United States has received its population, as have all other nations, by the immigration of various people, for no national populations are autochthonous, nevertheless the manner and circumstances of these settlements have been significant. Where England, Germany, France, Spain and other nations in prehistoric times or during ages of barbarism have been invaded, overrun or settled by the successive groups which now constitute their present population, the United States was settled in the full blaze of introspective history. Where European nations have taken millennia in the amalgamation and assimilation of their people, we have compressed the greatest migration in the history of man into three centuries. Where they have received neighboring people of similar culture or race, we have engulfed a native Indian people with representatives of every European people and forcibly inducted millions of African Negroes not to mention our acquisition of contingents from Asia.

Now, these circumstances of history and accident are pregnant with meaning for our future. Let us examine the consequences of these facts. It is, I think, a consideration of immense importance that this country was settled when it was, in a period of developed literacy and self-consciousness. Under such conditions, group identities and group traditions become quickly established and resist the solvents of time and association. The Pilgrim fathers and the Puritans, sharply aware of their peculiar status, intensified and immortalized it in their written records. The tradition thus created served to set apart its inheritors from all later comers unless they could by some means identify themselves with it. Similarly, the pioneer groups in the west lost no time in establishing their own legends and traditions which drew together in a common bond their descendants but shut out the settlers who followed them. Thus, there has grown up a system of hierarchies, local and national, which excludes whole sections of the population and erects barriers to assimilation and participation. In Europe where migration succeeded migration, priority of settlement confers no prestige. Indeed, if time is a factor at all, it is likely to be the latest conquerors coming in during historic and literate times who have a special exclusive tradition.

The rapidity of the settlement of the United States has also contributed to the fissures of our society. During the seventeenth and eighteenth centuries when immigration was relatively slow it was possible for newcomers arriving in small lots to become absorbed rather quickly, despite initial prejudices against them. But with the advent of the Irish and German waves of migration in the mid-nineteenth century, overwhelming numbers and differences in religion and culture created in the settled Americans an antagonism toward these newer immigrants which continued for a long time. With each succeeding wave and with the ever-increasing numbers, the fears and antagonisms were intensified. These we have inherited and will plague us in the future. Had these migrations consisted of Europeans only, we might look to their eventual absorption by the body of older Americans in the course of time, since the physical disparities are slight, the cultural ones disappear and only religious prejudices offer any obstacles. The injection, however, of large masses of Negroes and other non-European people into the population has created a profound schism. For these people bear with them the mark of their difference which neither cultural nor religious assimilation can efface. Thus, the welding of the American population into a harmonious community faces many difficulties whose final resolution requires tolerance and understanding. Without these essential attitudes we can expect aggravations of critical situations and serious dangers to our society.

When we look to the world beyond our borders we see there, too, the same forces of intolerance at work poisoning mutual understanding and respect, at a time when the technology of the future is likely to increase rather than to diminish the needs for international and inter-racial harmony. It is obvious, I think, that the task of building attitudes of tolerance, of fostering cooperation and of encouraging understanding in these matters is a long and tedious path. It is not a subject for evangelization. Not by an act of faith will the unregenerate become converted to the ways of tolerance. Only by the road of education and by the use of reason can we hope to create a lasting atmosphere of tolerance and cooperation.

In this effort we can, I believe, use with profit the lessons of anthropology, for it is the peculiar advantage of this discipline that it permits us to see mankind as a whole and to scrutinize ourselves with some degree of objectivity. All of us are born into a special group of circumstances and are molded and conditioned by them. Our views and our behavior are

regulated by them. We take ready-made our judgments and tend to react emotionally to any divergence from or interference with them. In a sense we are imprisoned in our own culture. Many of us never succeed in shaking off the shackles of our restricted horizons. But those who have been educated by experience or by learning to a broader view may escape the micro-culture of the specific group with which they are identified and achieve a larger perspective. I am sure that some of you may recall vividly the experience of an expanding world as you left behind the limitations of youth for the understanding and freedom of maturity. This is an experience which has its counterpart in the intellectual understanding of ourselves and of our culture which anthropology is able to impart. For anthropology deliberately undertakes to study man as a biological phenomenon like any other organism, and on its social side it seeks to lift the student out of his culture by treating it as one in many social experiments. Professor Boas once observed that his preoccupation with Eskimo culture permitted him to see his own with a fresh eye. Moreover, in placing man's struggle toward civilization in this perspective the anthropologist achieves a historical view which serves to correct the astigmatisms of the present.

In studying man in this fashion, anthropology teaches us among other things that civilization has never been the exclusive possession of one people and that the particular culture of any race or group of men is never the complete product of that race or group. Our own culture, stemming from western Europe, has roots in most of the civilizations of the past and has not hesitated to borrow from its living contemporaries. Our writing, for example, has come to us from Asia Minor via the Greeks; we have inherited principles of architecture discovered for us in Egypt, in the valleys of the Tigris-Euphrates and of the Indus; our knowledge of weaving probably originated in the Nile Valley, the use of cotton in India and silk in China. Egypt and Mesopotamia debate the honor of inventing agriculture and domesticating certain animals. From the American Indian we have received a variety of things such as food plants, snowshoes, the hammock and the adobe house; from the American Negro a rich source of music. The list of our borrowings and inheritances is long. Without them we could not have built our own civilization. Yet our debts have not made us humble. We behave as if we had created our civilization singlehanded and had occupied a position of leadership from the beginning of civilization itself. Actually, we are not only the inheritors of a varied and complex tradition, but the present protagonists of western civilization are merely the latest of mankind to become civilized. One might add that they unfortunately show it. All during the prehistoric ages northwestern Europe represented a back water. Into these remote regions came the stone age innovations after they had been invented elsewhere. Similarly, the neolithic techniques and the use of bronze and iron only slowly were diffused to western Europe centuries after their discovery in Egypt and Mesopotamia. So wild and barbarous were the regions inhabited by the ancient Britons, the Scandinavians and the Germans that the Greeks never even knew of their existence. And to the Romans the inhabitants of these far distant corners were uncouth barbarians unfamiliar with the amenities of civilization. In fact, up to the time of the Renaissance the northwestern Europeans could hardly claim parity by any objective standard with a civilization such as the Chinese of the same epoch, or the native civilizations of Mexico or Peru where substantial achievements in social organization, architecture and art far surpassed contemporary European productions. Well into the Christian era the archeological remains of British culture display a crudity, quite unprophetic of their future evolution. If, then, we justly attribute this backwardness of northwestern Europe in the ways of civilization to the accidents of place and history, how can we fail to admit the potentialities of our contemporaries who give evidence by their learning, by their arts or by their skills of accomplishments fully as great as those of the ancient Briton, Gaul or German.

Though we admit the superiority of western civilization in technology and science, anthropology is decisive in disclaiming any equivalent supremacy in the social organization of the nations of the western world. Indeed, it would be easy to enumerate examples among non-European people with more complicated social systems or with more efficient ones. If it is true that the magnitude of our commerce and industry, enlarged by the resources of science, has created a stupendous economic structure upon our society, it is also true that the social framework which supports it is in certain respects inadequate and inefficient. We who are so proud of our gadgets, who misjudge those who live on a simpler material plane, who scorn others for their superstitions, how are we to judge our ancestors of two or three centuries ago who lacked all that we prize in the way of material comforts and who believed in witchcraft? One can not help but feel that our attitudes are something like those of the little boy whose superior Christmas present elevates him above his less fortunate mates.

One of the most pernicious breeders of ill-will among various races of mankind is the doctrine that

a racial hierarchy exists based upon physical and psychological superiorities. It is interesting that the preferred positions in this scale are reserved for the race to which the claimants think they belong. Notions of superiority are, of course, widespread. They permeate groups of all kinds and sizes. The city slicker's airs of superiority over his country cousin are tinged with the same smugness that characterizes rival parishes or sets off the Scotch Highlander from the Lowlanders, distinguishes the Englishman from the British colonial, the Nordic from the Mediterranean, the white races from the colored. They are all based on the idea that differences are degrees of goodness, whereas in most instances differences are merely reflections of environmental adaptations, historical accidents, local developments or simply superficial physical mutations of no intrinsic value. During the nineteenth century these ideas crystallized around the concept of race largely through the writing of de Gobineau, who extolled purity of race and in particular the virtues of the Nordic. This was a period when many so-called European races had each their protagonists. The Mediterranean man was hailed as the culture hero of Europe. English writers drew racial distinctions among their own peoples but spoke instead of Kelt or Saxon or Norman and attributed to them exclusive virtues or vices. The attributions were so precise that it must have been a rash Saxon who would presume to write mystic poetry or a foolhardy Kelt who would aspire to martial glory.

Race, which started out as a zoological concept, a convenient method of classifying mankind according to physical criteria, much as the kinds of animals might be distinguished, thus became encrusted with psychological attributes and assignments of value. We all know how this monstrous doctrine has been elevated into a credo, how it has been used to inflame and manipulate masses of men, how insidiously it is calculated to make even those who attack it disseminate its seeds. Anthropology, which traditionally has been concerned with the problems of race, has here, too, much to offer in clarifying and correcting racial misconceptions fostered for evil purposes. Perhaps I might best summarize this in a series of principles.

(1) The racial classification of man is primarily a zoological concept. It attempts merely to classify and distinguish the varieties of men by physical criteria.

(2) Migration and intermingling has from his earliest history been characteristic of man so that "pure" races, if they ever existed, are no longer to be found in nature.

(3) The consequence of this intermixture has led to the overlapping of physical characteristics between neighboring people with a pronounced tendency for changes in any physical characteristic to be gradual so that it is practically impossible to set arbitrary lines of division between one type and another.

(4) The geographic extremes of these continuities do show pronounced differences in physical criteria, such as the northwest European, the Chinese and the Negro of Central Africa.

(5) No nation is exclusively of one race, or breed. In Europe especially prehistoric and historic migrations have mixed the various European strains inextricably. There is for example no Nordic Germany. So-called Nordic tribes settled in France, invaded Italy, overran Spain and even reached North Africa. Each nation in Europe represents a composite varying somewhat in their ingredients and proportions.

(6) The psychological attributues of race are nonzoological and logically have no place in racial classification. They are not coterminous with race, which itself is an abstraction.

(7) Moreover, since psychological attributes are commonly based on subjective judgments, are resistant to precise measurement, and are often profoundly influenced by environmental and cultural conditions, they are not suitable as criteria in the classification of races. Their use has led to tragic distortions of truth.

Parenthetically, I can not forbear pointing out the illusions we cherish in the name of practicality. The charge used to be leveled against anthropology that it was not practical, that it was remote from the important concerns of everyday living, and that it was largely absorbed in abstract and academic concepts. But now we are witnessing a world conflict in which these academic concepts play an enormous part and motivate the thinking of many of the actors. How practical it is then to keep these concepts free from distortion and to expose the fallacies which they engender!

In conclusion, let me congratulate the Cranbrook Institute and its director, Dr. Robert Hatt, on the splendid exhibit they are presenting this evening. It is, I think, a highly encouraging omen that they should take this pioneering step in the education of the public to understand the truths of racial and cultural variations. All too often the educational institutions and the museums of the country have shied away from their social duty in popularizing scientific knowledge when social problems are involved. It has always seemed to me an incomprehensible policy since it seems to imply that science is useful only when it can serve no purpose and useless when it has something to say. If we believe in science, let us bring it forth.

OBITUARY

WILMON NEWELL
1878–1943

. . . the work never is done while the power to work remains.

—*Mr. Justice Holmes.*

WORK was a passion with Wilmon Newell, as the record of his life reveals. He believed in hard work, seemed to have a thirsty zest for it, and he, setting the example, insisted on all those who were associated with him exerting their best and most efficient effort. He accomplished much in his field, but expressed regret at the end because "There are so many things I want to do."

His two greatest achievements—eradication of citrus canker and eradication of the Mediterranean fruit-fly—saved the citrus industry of Florida and the nation Citrus canker, a disease spread by a bacterium, came to Florida in 1911 on trees of trifoliate orange and satsuma from Japan and was recognized as a very dangerous menace to the citrus industry in 1914. Shortly after Dr. Newell assumed his duties as plant commissioner for Florida in 1915, he resolved, with surgical decision, to remove the canker growth from the industry.

The magnitude of the eradication task is recognized by bacteriologists and plant pathologists and is clearly shown by the record. Cankerous trees were found on 515 properties in 26 Florida citrus counties, and the only way in which it could be stamped out was to burn the affected trees. Nearly 250,000 grove trees and 2,740,000 nursery trees were destroyed in Florida, while 840,000 grove trees were destroyed in other citrus-producing Gulf states. The eradication campaign required twelve years and cost more than two and a half million dollars, but it succeeded in removing the canker threat to the nation's citrus industry.

Newell's second task for himself and his Florida Plant Board staff came in 1929, after his work and leadership in the canker campaign and other agricultural activities had, eight years before, resulted in his appointment to the dean's chair in the University of Florida College of Agriculture and director of the university's agricultural extension service and agricultural experiment station. The Mediterranean fruit-fly was discovered in a grove near Orlando, and a prompt survey revealed that it had spread to 20 of the state's heaviest producing counties. After learning that the fly had been found in Florida, Newell's decision was almost immediate: eradicate.

The Federal government approved of his eradication proposal and provided the major part of the funds for prosecuting the vigorous campaign which culminated eighteen months later in triumph over the pest. A greatly augmented Plant Board staff, many entomologists and hundreds of other workers were necessary to carry out the campaign. Since 1931 there has been no evidence of the fly in Florida.

These successful campaigns—against the canker and the Mediterranean fruit-fly—are considered two of the most remarkable achievements in the whole history of man's warfare against plant pests.

Before going to Florida, Newell served as entomologist in his native state of Iowa, in Texas, Georgia and Louisiana, and it was while he was chief entomologist for the Louisiana Crop Pest Commission that he developed the method of dusting with lead arsenate to control the cotton boll weevil and completed studies on the Argentine ant which provided the basis for control of this pest.

While in Texas he made extensive studies of bees and carried on bee-breeding experiments. He also originated the practice of burning colonies infected with American foul-brood to eradicate this disease, a practice that has been widely adopted by apiculturists.

In Florida, as director of the university's experiment station and, later (1938), as provost for agriculture at the university, his research activities were primarily of an administrative nature, his efforts being largely responsible for the great expansion of the experiment station and the employment of outstanding men to work on the state's agricultural problems.

His interest in the tung tree was responsible for the development of the tung industry in Florida and other Southern states. He initiated research at the Florida station which showed conclusively that tung trees could be grown profitably in the United States, and this research led to expansion of plantings to other states.

Always cognizant of the value of the great Everglades region, he inaugurated experiments which revealed that the fertile soil would produce bumper crops if it received applications of copper sulphate in the proper amounts. Rapid development of the highly important winter vegetable industry followed.

Research in all branches of Florida agriculture made noteworthy progress during his administration and the state's farmers, growers and livestock producers have received great benefits from the findings of the institution.

As director of the university's extension service, he employed well-trained, efficient and earnest men and women to carry on demonstration work over Florida, and the result has been notable improvement in individual farming and rural living.

In his desire to accomplish and serve he never spared himself and he asked the best and most energetic efforts, likewise, of those who served with him. He achieved much and the people of Florida and the nation have benefited from his labors.

HAROLD MOWRY

FLORIDA EXPERIMENT STATION

DEATHS AND MEMORIALS

AUGUST BUSCK, who served in the U. S. Department of Agriculture for more than forty-five years as specialist in Microlepidoptera, died on March 7 at the age of seventy-four years.

DR. MARGARET E MALTBY, associate professor of physics, retired, of Barnard College, Columbia University, died on May 3 at the age of eighty-three years.

DR. LIONEL ROBERT WILBERFORCE, professor of physics at the University of Liverpool from 1900 until his retirement in 1935 with the title emeritus, died on April 1 at the age of eighty-two years.

THE Smithsonian Institution, Washington, has been given a portrait of the late Dr. George Washington Carver. The presentation was made on May 2 by Vice-President Wallace

A RESOLUTION to designate February 11 of each year as Thomas Alva Edison Day in commemoration of his birthday was introduced in the Senate on May 2.

SCIENTIFIC EVENTS

THE U. S. NATIONAL MUSEUM

IN his report on the condition and operation of the U. S. National Museum for the fiscal year ended June 30, 1943, Dr. Alexander Wetmore, director of the U. S. National Museum, states that appropriations for the maintenance and operation of the museum for the year amounted to $892,630, which was $61,652 more than for the previous year.

Although there has been a decrease in the total number of visitors to the museum below that normal for times of peace, the number recorded, 1,355,269, indicates the great interest that exists in the exhibits. The change in hours to allow the public halls to be open all day Sunday has permitted many people to visit the buildings whose time schedules would not have otherwise made such visits possible. This is particularly true of service men and women, about 2,000 of whom have been included among the visitors each week end.

Last year's report described steps taken for the adequate safeguard of collections. These precautions have gone forward, and a program of training has been initiated among groups of employees for the protection of visitors, employees and the various buildings. Air-raid alarm systems have been installed, fire-fighting, air-raid and first-aid equipment procured, air-raid shelters designated, and complete black-out facilities where necessary established. Practice air-raid drills were held, both in cooperation with the District of Columbia and independently of the city-wide drills.

Throughout the year members of the staff have been occupied with work connected with the conduct of the war, either through direct contact with various war agencies or through the Ethnogeographic Board. This has included "spot" information in various fields, research and experiment. The variety of these subjects is indicated by the following enumeration of some of the items on which data were requested: Camouflage plants; natural vegetation of specific regions; illustrations of poisonous plants and of emergency food plants and data regarding them; destruction and mosquito-harboring epiphytes; distribution of certain plants of known economic importance; botanical exploration, the palatability of the flesh of land, fresh-water and marine animals, their use for food and methods of capture; the serviceability of hides and skins for various purposes; disease transmission; noxious, poisonous or otherwise dangerous animals; intermediate hosts of animal and human parasites; aid in the preparation of survival manuals and other military and naval handbooks; distributional lists of insects and other animals of medical importance; outlines for insect surveys in foreign areas; instruction in mosquito identification; collection and preservation of specimens, especially those of medical importance; supplying duplicate sets of insect material not otherwise readily obtainable for the use of Army and Navy medical schools; biological and oceanographic problems; marine fouling organisms; bibliographic surveys; recommendations regarding personnel.

Assistance has been given in the identification of tribal culture patterns chiefly of the island peoples of the West Pacific area and of continental southeastern Asia. Other information provided, in this instance obtained from museum photographic files, related to the need of our aviators and soldiers to recognize religious caste markings, and, to assist in the orientation of aviators, the types of house construction in various parts of southern Asia. A mass of information directly based on the collections was given to such agencies as the Board of Economic Warfare and the War Production Board, bearing directly on the development of the use of substitute materials for civilian use. Various articles describing the more remote

peoples and their cultures were prepared and published.

The museum collections were increased by 230,231 specimens, which were included in 1,177 separate accessions. Because of wartime conditions a decrease of 211 accessions, 54,351 specimens, in comparison with the number received during the previous year, was not unexpected. The five departments registered specimens received as follows: Anthropology, 2,514, biology, 213,823; geology, 9,725; engineering and industries, 2,266; and history, 1,902. Most of the accessions were acquired as gifts from individuals or as a transfer of specimens by government departments.

THE NEW ENGLAND ASSOCIATION OF CHEMISTRY TEACHERS

THE sixth annual summer conference of the New England Association of Chemistry Teachers will be held from August 24 to 28 at Connecticut College, New London. The program will include a symposium on oxidation-reduction and papers on recent developments in various fields of chemistry. Consideration will also be given to post-war teaching problems in the sciences.

Although the summer conferences are held primarily for the benefit of members of the association any one interested will be welcome. Connecticut College, a privately endowed liberal arts college for women, opened for study in 1915. It is situated on a hill-top overlooking the town of New London, Long Island Sound, the Thames River and the hills of eastern Connecticut. A spacious campus surrounding modern granite buildings is supplemented by a hundred-acre arboretum with lake and out-of-door theater. Ocean Beach Park, a new recreation and bathing beach conducted by the City of New London, can be reached in twenty minutes by convenient bus service.

New London is situated midway between New York and Boston on the Shore Line of the New York, New Haven and Hartford Railroad; excellent roads from several directions are available to those able to go by automobile, and bus service is frequent. The summer session of the college will be in progress during the period of the meeting.

Details concerning fees will be published in the June issue of the *Journal of Chemical Education* and the complete program will appear in the July issue. All communications concerning the conference should be addressed to the secretary, Miss Helen Crawley, 45 Lawton Road, Needham, Mass.

ACQUISITION OF A BIRD COLLECTION BY THE NEW YORK STATE MUSEUM

THE section of zoology of the New York State Museum in Albany on April 15 acquired through purchase a notable collection of birds. The collection consists of 390 study skins representing 165 species and subspecies collected principally in Lewis County, New York, by the late James H. Miller, of Lowville. A few of the species represented were taken in Connecticut and Florida.

Mr. Miller, who died in November, 1943, was one of the collaborators of the late Professor E. H. Eaton in the preparation of his notable study of "Birds of New York" (New York State Museum Memoir 12, Part 1, 1910; Part 2, 1914). For that publication Mr. Miller contributed many records, photographs and other data. This information was supplied in part through the specimens which he collected in Lewis County and which comprise the bulk of the recently acquired collection.

Most of the skins were prepared by Mr. Miller and are beautifully done. Each specimen bears collecting and other data on the specially printed tags which he designed. The birds were taken between the inclusive dates 1881 and 1916 and are in an excellent state of preservation.

In addition to the specimens themselves, the museum has come into possession of the oak storage cabinet in which they were housed and which Mr. Miller made with his own hands, also his handwritten catalogue pertaining to the collection, an abbreviated journal relating to certain of his ornithological observations in the Lowville area and a few other incidental items.

Among the rarer New York State specimens in this collection are three Canada spruce grouse, a golden eagle, two Brunnich's murres, a great gray owl and two northern ravens. Several interesting seasonal and distributional records also are confirmed by specimens, as are other features of ornithological interest.

The collection in question is of considerable importance and value to ornithologists of the northeastern states generally and to those of New York State in particular. It provides tangible data of scientific, historical and sentimental value Its final resting place in the State Museum could not have been more appropriately chosen.

A complete annotated list of the material in this collection is in course of preparation and in due time will be made available to those who may be interested.

DAYTON STONER,
State Zoologist of New York

THE ANNUAL SESSION OF THE AMERICAN MEDICAL ASSOCIATION

THE *Journal* of the American Medical Association for May 6 prints the program for the ninety-fourth annual session of the association to be held in Chicago from June 12 to 16 under the presidency of Dr. Herman L. Kretschmer, professor of urology at the Rush Medical College. Editorial comments in the *Journal*

on important events of the meeting read in part as follows:

The program indicates the great advance that has been made by medical science in recent years Panel discussions on tropical medicine, chemotherapy, plasma and neuropsychiatry, already arranged for the general scientific meetings, emphasize these chief lines of interest

The very first paper scheduled for the section on practice of medicine deals with penicillin. Additional manuscripts cover current topics, such as rheumatic fever, and there is a panel discussion on vitamins, amino acids and enzymes In the Section on Surgery the use of surgical technics in hypertension and new technics related to methods of suture are featured. The opening session of the Section on Obstetrics is concerned with problems of pregnancy, but attention is given also to new studies with hormones and to complications related to the bladder. A symposium on penicillin features the Section on Laryngology, and one on rheumatic fever appears in the Section on Pediatrics Unusual is the symposium on the abuse of rest in the treatment of disease, scheduled for the Section on Experimental Medicine. Prominent in the program on nervous and mental diseases is the panel discussion on operational fatigue in combat air crews. All the newer investigations in the intensive and modern treatment of syphilis are included in a full session of the Section on Dermatology and Syphilology; in these discussions the investigators who have been doing most of the work for the Office of Scientific Research and Development are cooperating. New attitudes in industrial medicine and a consideration of the relocation of physicians in the postwar period are listed for the Section on Preventive and Industrial Medicine and Public Health. In the Section on Urology the new advances in the treatment of cancer of the prostate are noted, and in the Section on Orthopedic Surgery space is provided for the report of the committee which is making a joint investigation of the Kenny technic. The Section on Anesthesiology gives opportunity to hear the last word on continuous caudal analgesia. Especially interesting also are the sessions of the Section on Miscellaneous Topics, devoted on this occasion to the interests of the general practitioner.

The scientific exhibit and the other usual features of the annual session will be up to the standard of peacetime and will be high-lighted as well by the interests associated with the needs of war. Attention is called to the motion picture theater, which will offer continuously from the first day the latest demonstrations utilizing visual education

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he became a prisoner of war, and was exchanged in December, 1943.

DR. ITALO F. VOLINI, since 1929 professor and head of the department of medicine of the School of Medicine of Loyola University, has been appointed dean of the school for the duration of the war. He will take the place of Commander Francis J. Braceland, on leave with the Navy.

DR. GEORGE W. WILSON has been appointed dean of the School of Dentistry of Marquette University. He succeeds Dr. Henry L. Bauzhaf, who has been made dean emeritus.

DR. FLORENCE L. BARROWS has been appointed assistant professor of botany and chairman of the department of botany of Wheaton College, Norton, Mass.

AT the University of London, Dr. J. M. Mackintosh has been appointed from October 1 to the chair of public health, tenable at the London School of Hygiene and Tropical Medicine.

DR. OTIS W. CALDWELL, of the Boyce Thompson Institute for Plant Research at Yonkers, N. Y., general secretary of the American Association for the Advancement of Science, has become a member of the Board of Trustees of Science Service.

DR. EUGENE M. LANDIS, professor of physiology at the Harvard Medical School, has been elected a member of the Council on Pharmacy and Chemistry of the American Medical Association, to fill the unexpired term of Dr. William C. Rose, professor of biochemistry at the University of Illinois, who has resigned owing to the pressure of other work.

DR. A. L. ROBINSON, professor of chemistry at the University of Pittsburgh, has been placed on half time by the department of chemistry so that he may serve as acting librarian of the university. Dr. Robinson has been chairman of the Library Committee of the department for many years, and for the past several years has been chairman of the Senate Committee on Library and Publications of the university.

WALTER G. CAMPBELL, U. S. Commissioner of Foods and Drugs of the Federal Security Agency, previously from 1933 to 1940 chief of food and drug administration of the U. S. Department of Agriculture, has retired.

DR. JOEL B. PETERSON, research chemist of the White Laboratories at Newark, N. J., has joined the department of applied research of Standard Brands, Inc., as technical consultant for pharmaceuticals.

THE thirteenth Joseph Henry Lecture, entitled "Faster Than Sound," was delivered on April 29 before the Philosophical Society of Washington by Dr. Theodor von Kármán, director of the Guggenheim Aeronautics Laboratory of the California Institute of Technology.

DR. WILLIAM H. SEBRELL, chief of the Division of Chemotherapy of the National Institute of Health, will deliver on May 18 the eighth Harvey Society Lecture of the current series at the New York Academy of Medicine. He will speak on "The Relation between Sulfonamide Drugs and Vitamin Deficiencies."

THE annual oration of the Massachusetts Medical Society will be delivered by Dr. Joseph C. Aub, associate professor of medicine at the Harvard Medical School, at the annual meeting to be held on May 22, 23 and 24. He will speak on "The Toxic Factor in Traumatic Shock" The Shattuck Lecture will be given by Dr. Alfred Blalock, professor of surgery at the School of Medicine of the Johns Hopkins University. The lecture is entitled "A Consideration of Certain Recent Advances in Surgery."

DR. ROBERT CUSHMAN MURPHY, of the American Museum of Natural History, lectured on April 14, Pan American Day, before the students and faculty of Smith College. He spoke on "Climate, Nature and Man in Northwestern South America."

DR. VALY MENKIN, of the Fearing Research Laboratory of the Free Hospital for Women at Brookline, Mass., was the guest speaker on April 24 at the meeting at the University of Michigan of the American Academy of Periodontology. He gave two lectures on the "Dynamics of Inflammation."

DR. WALTER R. MILES, professor of psychology at Yale University, at a meeting on April 20 of the Iowa State College Chapter of the Society of the Sigma Xi, discussed psychological problems arising under conditions of military flying. His lecture was entitled "Psychology and Military Aviation."

THE centenary of the American Psychiatric Association will be celebrated at a meeting to be held in Philadelphia on May 15 and on the three following days. Advances made in military psychiatry and the steps now being taken to rehabilitate psychiatric casualties will be discussed. Other subjects on the program include child delinquency, psychological first-aid in the public health service, industrial mental hygiene, child psychiatry and psychiatric nursing, convulsive shock therapy, pre-frontal lobotomy, electroencephalography, psychosomatic medicine, alcohol neuroses and sleep disorders. There will be sessions devoted to psychiatry and the United States Army, psychiatry and the United States Navy, rehabilitation and psychoneuroses. The meeting will be formally opened on Monday morning, with Dr. Edward A.

Strecker, of the University of Pennsylvania, presiding. The incoming president, Dr. Karl M. Bowman, of the Medical School at San Francisco of the University of California, will be inducted into office on Thursday.

THE celebration of the sixtieth anniversary of Memorial Hospital for the Treatment of Cancer and Allied Diseases, New York, N. Y., opened on May 6. There were no formal anniversary exercises. May has been designated as anniversary month with special emphasis on cancer education for the public, and a series of lectures on "The Challenge of Cancer" will be given on successive Saturdays at 11 A.M. in the hospital auditorium.

A NEW laboratory specially equipped with high-frequency heating apparatus has been established by the department of chemical engineering of Columbia University. It will have the cooperation of technical experts of the Induction Heating Corporation of New York, which provided the high-frequency equipment for the laboratory. The department of chemical engineering will have full authority in guiding the program and in publishing the results of research. The laboratory is under the direction of Professor Arthur W. Hixson, head of the department, and Professor Philip W. Schutz. Everette K. McMahon, a graduate of the Georgia Institute of Technology, specialist in the applications of high-frequency heating, is in charge of the laboratory.

DISCUSSION

BASIC BIOLOGY AND GENERAL EDUCATION

IT is unfortunate that the multiplicity of objectives of college and university students has not been brought to the fore in the recent discussion of the teaching of general biology, which is part of a very important and far-reaching problem in college and university teaching.[1, 2] It is likely that few scientists would disagree with one of the writers cited[2] that for the education of professional biologists, detailed and systematic introductory courses in each of several important branches of biology are indispensable. However, it is not for such students that courses of more comprehensive scope and less complete detail should, in the opinion of the present author, be designed or offered.

It is unfortunately a fact that very large fractions of college and university students now leave such institutions without appreciable contact with modern science. Our choice as educators in science is not between presenting the broad range of knowledge about nature to students in many systematic courses covering individual areas of specialization, and its presentation in a more comprehensive manner. The limitations of time in four college years make it impossible to include a detailed treatment of even the major subdivisions of the sciences along with the other desirable content of the modern college curriculum. The practical alternative which is actually open to us seems to be the choice between the more comprehensive and less detailed course and nothing.

The peculiar virtue of the American educational system is its extensiveness. The American system has many weaknesses, but it has apparently been good enough to allow the people to operate a reasonably satisfactory democratic system. Our colleges and universities may be inferior to some others, for example, the old German, in intensiveness of training offered to the majority of their students. It does not follow, however, that they perform a less useful service. To provide a modicum of college training to about ten times the proportionate number of young people in the population is an achievement of American education to be borne in mind when the virtue of one or another educational policy is to be decided. Such education has apparently performed a great service in the past by creating a broad base of fairly well-informed citizens in the democracy. But our training of students in science is becoming poorer by the year because of the greater emphasis on vocational and professional training. The teaching of science has reached a low ebb, as far as non-science students are concerned. Something constructive will have to be done to turn the tide. Our old offerings have been rejected. The present problem is to find new ways to accomplish old ends.

We are living in an age of greatly expanding knowledge in science. If our people are to have some useful appreciation of this increase in scientific information is it not reasonable that the colleges and universities should offer their students courses with broad enough scope so that an introduction to the whole range of science is possible within the limitations of time of a college curriculum? This question can not be answered by evasion because it is on the public mind as well as our own. If we do not give a satisfactory answer, the public or college administrators may give it for us in the form of a directive, perhaps less congenial to us and less useful to society than our own solution could be.

The problem of specialized versus general courses is not one of either-or. There is no bar to maintaining every essential introductory course in a field of specialization, designed for smaller numbers of serious stu-

[1] Gordon Alexander, SCIENCE, Vol. 99, January 28, 1944.
[2] C. A. Shull, SCIENCE, Vol. 99, March 10, 1944.

dents in related fields, and at the same time offering to the large mass of students without such professional objectives an opportunity to get at least a bird's-eye view of the field under competent tutelage. In many instances existing courses for non-technical students can be altered, combined or rearranged to meet the existing need. If some such solution is not found we shall have no right to complain when the American people derive their notions about evolution from William Jennings Bryan, about animal experimentation from Irene Castle or William Randolph Hearst and about medicine from B. J. Palmer or Mary Baker Eddy.

A university must and does serve many functions. It seems that it is not too much to ask that it carry out its job of giving its graduates as least a speaking acquaintance with the scope of science. The vexatious problem of the vested interests of specialty groups, anxious to avoid loss of prestige and financial support through a decrease in numbers of students in existing courses, should not be allowed to stand in the way of achievement of a goal, larger by far for both science and society than the disarrangements it will require for its achievement.

As a specialist in a branch of biology directly involved in the program under discussion, I am anxious to see the most important facts and principles of that branch be known and appreciated by as large a fraction of the public of which we are a dependent part, as is reasonably possible. I am convinced, first, that there will be no loss in prestige or economic support for that science as a consequence, and second, that such education will improve and enrich the lives of the generation acquiring it. It seems very likely that the whole realm of basic sciences would receive the greatest impetus possible if the people at large had even the barest sort of conception of how applied science rests upon progress in pure science. Many scientists to-day complain bitterly about the partiality of the public in the support of applied as opposed to pure science. There is little to be wondered at in such discrimination, since any one who can read knows something about the achievements of applied science. If we in the basic sciences are unwilling to play our part in mass education in the essentials of the pure sciences we shall have no one to thank but ourselves for the discrepancy in support that will result.

A corollary of the argument I have made is that professional students of science need a great deal more acquaintance with the literary, artistic and social heritage of the human race than they now acquire. The general cultural education problem has many facets, and although I have stressed only one because it is in my province as a teacher, I can not refrain from inserting the suggestion that the general education of scientists, pure and applied, deserves a much greater emphasis upon cultural phenomena than it has received in the recent past, and that comparably comprehensive presentations in these areas will assist greatly in meeting this need.

A move in the direction of less fragmentation into small subdivisions in the teaching of science to students without professional objectives in the areas in question seems to offer the best hope we have for the restoration of opportunity to college students to acquire a liberal education in the best sense. It presents an opportunity to make many more citizens intelligently aware of the importance of basic science to applied science and human welfare. It need not detract an iota from the thoroughness of training of specialists in science, nor decrease the prestige or financial support of basic science departments. In fact, it seems that to extend support for work in the basic sciences, greater public appreciation of their important role in human welfare is much needed.

MAURICE B. VISSCHER
UNIVERSITY OF MINNESOTA

GREGOR MENDEL'S EXPERIMENT ON THE NATURE OF FERTILIZATION

IN "The Evolution of Genetic Systems," C. D. Darlington reviews "the three vital experiments" on which modern genetic principles are founded: 1—the proof by Johannsen that the genotype is independent of the environment; 2—the proof by Gregor Mendel that the genotype is composed of indivisible parts; 3—the proof by the same Mendel that fertilization and normal plant development involve the union of one egg and one pollen-grain.

While Johannsen's beans and Mendel's peas have become classical, Mendel's second contribution has remained almost unknown. In a seminar course "based principally on outstanding contributions that have marked great advances in the theory and the application of genetics," we have retrieved this Mendel experiment, locating the account in the eighth of the ten letters from Mendel to the German botanist, Carl Nägeli.[1]

It is interesting that Mendel conducted his experiment in 1869, five years before Oscar Hertwig observed the fusion of egg and sperm nuclei of sea urchins and thus discovered the basic principle of fertilization.

How little understood this principle was only seventy-five years ago can best be appreciated by quoting that passage of Darwin's[2] which caused Mendel to undertake his experiment:

[1] "Gregor Mendel's Briefe an Carl Nägeli, 1866–1873," Herausgegeben von C. Correns. *Abhandlungen der Mathematisch-Physischen Klasse der Königlich Sächsichen Gesellschaft der Wissenschaften*, 29: 3, 235–236, 1905.

Quatrefages has shown in the case of the *Teredo*, as did formerly Prevost and Dumas with other animals, that more than one spermatozoon is requisite to fertilize an ovule. This has likewise been clearly proved by Newport, who adds the important fact, established by numerous experiments, that, when a very small number of spermatozoa are applied to the ova of *Batrachians*, they are only partially impregnated, and the embryo is never fully developed; . . . With respect to plants, nearly the same results were obtained by Kölreuter and Gärtner. . . . The pollen-grains of *Mirabilis* are extraordinarily large, and the ovarium contains only a single ovule; and these circumstances led Naudin[3] to make the following interesting experiment: a flower was fertilized by three grains and succeeded perfectly; twelve flowers were fertilized by two grains, and seventeen flowers by a single grain, and of these one flower alone in each lot perfected its seed, and it deserves especial notice that the plants produced by these two seeds never attained their proper dimensions, and bore flowers of remarkably small size. From these facts we clearly see that the quantity of the peculiar formative matter which is contained within the spermatozoa and pollen-grains is an all-important element in the act of fertilization, not only in the full development of the seed, but in the vigour of the plant produced from such seed.

The following is Mendel's own story of his experiment:[4]

Because of my eye trouble, I was unable last year to undertake further hybridization experiments. Only one experiment appeared to me so important that I could not make up my mind to postpone it to some later date. It deals with the view of Naudin and Darwin that a single pollen-grain is not sufficient for an adequate fertilization of an egg. As experimental plant I used *Mirabilis Jalappa*, as did Naudin; the result of my experiment, however, is an entirely different one. I obtained from fertilization with single pollen-grains eighteen well-developed seeds and from them as many plants, ten of which are already in bloom. The majority of these plants are just as fully developed as those derived from free self-pollination.

A few specimens, however, have until now lagged somewhat in growth, but to judge from the success of the others, the reason can only be found in the circumstance that all pollen-grains do not possess the same faculty to fertilize; and, furthermore, that in these particular experiments the competition of other pollen-grains was excluded. Where several compete, we may assume that always the strongest succeeds in alone effectuating the fertilization. However, I intend to repeat these experiments; also one should be able by an experiment to ascertain directly whether in *Mirabilis* it is possible for two or more pollen-grains to participate in the fertilization of one egg. According to Naudin at least three would be required!

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[2] Charles Darwin, "Animals and Plants under Domestication," Vol. 2, Chapter 27, pp. 435–436, 1868.

[3] M. Ch. Naudin, "Nouvelles recherches sur l'hybridité dans les végétaux," *Nouvelles Archives du Museum d'Histoire Naturelle*, Paris, Vol. 1, pp. 35–37, 1865.

[4] Excerpt from a letter written by Gregor Mendel to Carl Nägeli, dated July 3, 1870. (Translation from German.)

FACILITATE HUMAN ENDEAVOR THROUGH COLLEGE TRAINING IN SCIENTIFIC METHOD

DR. ANTON J. CARLSON makes several points in his statement about Dr. Cattell's service to science[1] that need a lot more emphasis: (1) "Scientific method should be applied to all fields of human endeavor; (2) education (even in the sciences) is largely memory conditioned by traditions and faith rather than by the exercise of reason based on understanding; (3) human curiosity, human want and human pain are potent spurs; (4) keep your mouth shut and your pen dry till you know the facts."

Most of us will agree with the good doctor "that all men should have a good workable knowledge of scientific method," but he would be the first to point out, I am sure, that thus far the percentage of men who could thus qualify would be very small indeed.

The scientific attitude or viewpoint is comparatively rare, my observation forces me to say. The responsibility for this rests, in part, on our schools and colleges —or on what Dr. Carlson calls "the 'Quiz Kid' ideal of *what* rarely proceeding to the *evidence* and the factual *why*."

To capitalize on human curiosity, instead of stifling it as happens so often in our schools now, I suggest that our colleges offer a full year's course in "Scientific Methods," and that such a course be required of all freshmen.

The accompanying outline covers the essentials of such a course, I submit, because it is basic, fundamental, broad in scope and provides orientation through the active participation of leaders in the various fields of endeavor. It is my thought that every college student should get an idea (1) of the mechanics of thinking, analysis or research, both technical and market; (2) of what is being done in research in biology, chemistry. geography, physics, marketing, etc.; (3) of statistics, semantics, logic; (4) of personal aptitudes; (5) and that he should learn when to keep his mouth shut.

A Tentative Outline of a Year's Course in "Scientific Method":

(1) Spirit and basic principles of scientific inquiry (2).
(2) Current research activities, needs, opportunities (4).
(3) Isolation and statement of problems (1).
(4) Technical and market research methods, public opinion polls (6).

[1] SCIENCE, 99: 2565, 158, 159.

(5) Sources of research material (1).
(6) Readings in literature of research.
(7) Orientation in the various sciences and fields of endeavor (9).
(8) Aptitude tests and personal problems (2).
(9) Elementary principles of statistical methods (4).
(10) Semantics (4).
(11) Logic—with particular reference to fallacies (2).
(12) Presentation of research reports (1).

Obviously, such a course could not be handled by any one instructor; it should be handled by the leaders or best speakers in the various fields. One of the by-products of this would be considerable vocational orientation or guidance.

The numbers in parenthesis cover, tentatively, the number of weeks' study that I would devote to each of the various general topics.

This course is not presented as a panacea or cure-all—but it can help do some of the things that James McKeen Cattell fought for for over fifty years and which Dr. Carlson advocates to-day—extend the use of scientific methods

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STARRING SUBJECTS IN "AMERICAN MEN OF SCIENCE"

IN view of the long service rendered by J. McKeen Cattell to science in our country it would seem appropriate to devote considerable space to his life work in SCIENCE. I would be especially interested in a discussion of the advantages of starring men in "American Men of Science." It seems to me that it is very important for the progress of science that the achievements of those working in this field should become known more widely and more reliably than is now customary.

If the methods adopted by J. McKeen Cattell can be replaced by better ones it is highly important that this should be done. I realize that it is very difficult to find methods of procedure which will be generally acceptable, but this does not seem to be a sufficient reason for not considering the possibility of improvement. I have heard many favorable comments on the success of J. McKeen Cattell along this line, and it seems to me that we could honor him mostly by considering the possibility of improvements of his methods.

G. A. MILLER

SCIENTIFIC BOOKS

WILLARD GIBBS

Willard Gibbs. By MURIEL RUKEYSER. xi + 465 pp New York: Doubleday, Doran and Company, Inc. $3.50.

I HAVE always found it hard to write about Willard Gibbs. Neither my brief biographical sketch in the Dictionary of American Biography nor my Gibbs Lecture before the American Mathematical Society seems to me quite satisfactory. It may be a significant fact that in the forty years since his death none of his pupils, colleagues or friends have written so extensively about him as an English science writer, J. G. Crowther, or a native poet, Miss Rukeyser, whose whole background seems very remote from that of Gibbs.

There are two excellent biographical notices of Willard Gibbs. The one first published is by H. A. Bumstead, his pupil and colleague for the last decade of his life; it prints fifteen pages at the head of the first volume of "The Scientific Papers of Willard Gibbs." The second is by C. S. Hastings, who was his pupil during the first year of tenure of his professorship of mathematical physics, and who, except for a brief period of service away from Yale, was his colleague until the time of his death; it fills about twenty pages of volume 6 of the "Biographical Memoirs" of the National Academy of Sciences. These two notices represent Gibbs as I knew him better than I can; they deserve the most careful study by all who would know him as he appeared to his contemporaries, old or young.

The sixty-five pages Crowther devotes to Gibbs leave me rather cold. They constitute an interpretation rather than a biography, and much of the interpretation seems very dubious. The start is from: "The problem of Gibbs is the discovery of the explanations of his simultaneous greatness and obscurity, the nature of his own work, the influence of his personal psychology and social environment, and the social history of the United States."

One who sets himself such a task can hardly do otherwise than mold objective facts to his subjective philosophies. So far as I can see, Gibbs never suffered obscurity in matters that really counted—professor at 32, subject of Maxwell's praise at 35, elected to the National Academy at 40, called to Johns Hopkins a year later, recipient of the Rumford Medal within another year, he seems not at all to have suffered the fate of Gregor Mendel or Hermann Grassmann.

Later Crowther writes: "Is it possible that Maxwell's intelligibility was a reward for social conscience, and that Gibbs's unintelligibility was a penalty for the belief that he had no duty to ensure that his discoveries were understood and used?"

As to intelligibility or unintelligibility let me say that in the days when I was teaching Maxwell's electromagnetic theory and Gibb's thermodynamics I cer-

tainly did not find that the former's "Electricity and Magnetism" was any more intelligible than the latter's "Equilibrium of Heterogeneous Substances." It is likely that such great new syntheses can not well be entirely perspicuous. Was Newton's "Principia" quite intelligible to his immediate contemporaries?

The psychoanalytic interpretation which Crowther offers for some of Gibb's characteristics and the statement that his mouth has a petulant, disagreeable curl (in a reproduction from an early daguerreotype) seem to me not only highly speculative but extremely doubtful. I have examined the original daguerreotype with care but can see no petulance, and as to mother fixation, transference to an elder sister, symbols of persistence of his father's authority, and the disappointment of an unconscious psychological motive, I can only say that nothing I ever heard about Willard Gibbs gives me any inkling that Crowther is on sound ground.

The attention given to Crowther's essay is a necessary precursor to Miss Rukeyser's work because she leans so heavily upon him. In place of his sixty-five pages she gives us four hundred and fifty, diluted with more (and more exaggerated) interpretations and inflated with much matter alien to the story of Gibbs and his work—Melville, Whitman, Percival, J. Q. Adams, Henry Adams and William James figure at considerable length. The book is the author's interpretation, not only of Gibbs and his work, but of the sweep of American history from before his birth to the present time. It is different history from any I have read and a different Gibbs from him I knew. The author is a literary woman rather than a historian or scientist; she states as facts a great many things she can not possibly know, such as what some one felt or thought on a given occasion, even though there be no record to indicate it. As fictionalized biography has a great present vogue, many must like it and some may even consider this one "thrilling" in the places where it is best written, though I should think any one must consider a good deal of it as both badly written and boresome.

Miss Rukeyser starts her book with a frontispiece portrait of Gibbs which is new to me and which I should never have recognized. On the flyleaf she places a quotation from William James: "'They laugh best who laugh last.' Wait until we are dead twenty years. Look at the way they're now treating poor Willard Gibbs, who during his lifetime can hardly have been considered any great shakes at New Haven!"

Whether it is fair to take this quotation out of its context, I doubt, but it surely fits the author's purpose of drawing Gibbs as a prophet without honor in his own university or country. For over forty years I have discussed this matter with many persons and find few who consider it a just judgment.

In livery, driving
his sister's coach in the city.

So wrote Miss Rukeyser in her poem on Gibbs. She now takes this back in the sentence: "And the legends grew, until people would come to say that Willard Gibbs wore livery driving his sister to market, which was not only a lie, but ridiculous to anyone who knew the circumstances of New Haven, or the family, or the gentle habits of these people."

Nevertheless, she does not take back the general implication of Gibb's subordination to his sisters and, as in other passages in her poem, she maintains *à l'outrance* the thesis that he avoided life and living:

> Silent, inhibited, remote [p. 4].
>
> Gibbs tore himself down until his life was nothing but self and science, and then he tore the self away [p. 6].
>
> . . . a careful withdrawal from personal life, a careful destruction of personal tokens [p. 12].
>
> Hesitation had come to be a deep current in his life [p. 220].
>
> That was the pale life,—whose letters were torn up, burned, anyway destroyed [p. 430].
>
> All the burden of withdrawal has been his [p. 433].
>
> He carried the tragedy of his own restraint, and it grew into an immense and jungle growth [p. 436].

May the author live to recant also this exaggeration, calling it lies and ridiculous!

So far as those who knew him could judge Gibbs was one of the most happy and serene of persons. I can not do better than to quote Hastings:

> Nothing is more difficult in a biographical memoir than to give the reader a definite impression of the personal characteristics of an eminent man, of those characteristics which make the man in the eyes of such of his contemporaries as are unable to estimate him by his works. On the other hand there is no more legitimate curiosity than that which prompts us to seek such information about a man who has impressed himself upon his times by his essential greatness. In many cases a mere accumulation of incidents in the life of one who has numerous points of contact with his fellow-men is all that is necessary for a discerning reader; but with one whose activities are chiefly intellectual this is often difficult, and particularly so with Professor Gibbs, who seems never to have sought or desired a wide circle of acquaintances. But we should greatly err if we concluded from this that Mr. Gibbs was of an unsocial nature. To me he always appeared quite the opposite—perfectly friendly and approachable, ready to talk on any subject, and always equable, he exhibited a flattering welcome to every friend. Effusiveness was as foreign to his nature as insincerity, but cordiality was never wanting. He laughed readily and possessed a lively sense of humor.

There is one thing I might add. Time was when we did not so much concern ourselves with superficial "personality" or behavior as with the substratum called character, and when we believed that the university,

the church and the courts, however so much they might profit by talent, served their essential social purposes chiefly through the integrity of character of their personnel, through uprightness, sincerity and faithfulness to principle. It was the high character of Willard Gibbs that impressed me even more than his great talent.

Miss Rukeyser says of him:

His faith lay in a few often repeated words which come down through the memory of his friends, his friends' children, his students:

"Mathematics *is* a language."

"The whole is simpler than its parts."

"Anyone having these desires will make these researches."

I can not recall that Gibbs was ever trite or hackneyed; if he repeated these or similar sayings often, it certainly was not in my hearing; indeed I never before heard any one suggest that he made the third of these statements.

Miss Rukeyser tries hard to give an intelligible account of Gibbs's contributions to science. It is a difficult task. I shall not attempt to assess failure and success of this effort at popularization; I should, however, like to refer to two items:

1. This was a man whose acceptance of his culture seemed to stop short only at the borders of his scientific labor.

I believe that Gibbs's "acceptance of his culture" was as clear in his scientific work as it could have been anywhere else—neither more nor less. His work was done in that great period of culmination of the victories of Newtonian mechanics. About two hundred years after the "Principia," we find among other important contributions that, in the decade 1870–1880, Lord Rayleigh published his elegant "Theory of Sound," Maxwell his "Electricity and Magnetism," Gibbs his "Equilibrium of Heterogeneous Substances." Gibbs applied, with great care and exceptional intuition and with very wide acquaintance with physico-chemical facts, the concepts of equilibrium mechanics, particularly the technique of virtual work, to systems that were heterogeneous, specifying with precision the conditions that must hold for the great variety of infinitesimal displacements from a state of equilibrium which were possible when the substances were heterogeneous.

2. As the influence of Gibbs's work grew, the tragic waste, directly or indirectly traceable to ignorance of the laws he had stated, became more dramatic. The most heroic appearance is the story found in full detail in the heartbreaking record of Captain Scott's expedition to the South Pole during the iron winter of 1912. Crowther repeats the belief that Scott and his party died through ignorance of the phase rule.

Crowther's statement is:

It is said that the lives of the English explorers, Captain Scott and his party, were lost in the Antarctic, owing to ignorance of the phase rule. When they started on their return from the South Pole, they found the fuel oil can in one of their depots was empty. The solder of the can contained tin, which may exist in different phases. At low temperatures block tin may fall into powder, and cans soldered with it become unsealed. This appears to have happened to the cans upon which Scott depended for survival.

I can find nothing in the writings of Gibbs, all of which I have reread since undertaking this review, which would serve to predict what new phases will occur. He states in several places that this sort of knowledge must come from observation. He says nothing about tin, let alone solder, which contains a good deal of lead. Moreover, he emphasizes the existence of passive resistances to change of phase which permit substances to exist in states far beyond the limit of absolute stability.

I can find no evidence in the literature or from private advices which I have sought widely that in fact solder in cans does degenerate in the cold. Moreover, the rather competent scientific observers of the expedition report in the official account that the tins at the depots awaiting the Southern Party had been opened and the due amount to be taken measured out by the supporting parties on their way back, and they attribute the lack of fuel to evaporation or leakage through the stoppers.

However, this "heart interest story" is now in the literature through the statements of Crowther and Rukeyser and may well remain in it a long time; so, too, I fear, will a lot of other errors about Gibbs and his work which Miss Rukeyser has incorporated in her fictionalized biography, and for which I can see no excuse even in her political or social or emotional ideas or ideals.

Without extending the review to quite impracticable length, it would be impossible for me to list the items which I believe to be wrong, and in many cases it would be entirely out of the question to determine whether they were wrong. For example, she writes in connection with Gibbs's death: "His digestion had always bothered him, and suddenly he suffered a violent and acute attack." What may be her authority I can not guess. So far as my information goes Gibbs's digestion had always been satisfactory. His fatal attack, diagnosed as intussusception, need not have been and I believe was not preceded by any considerable premonitory period of indigestion. It is certainly not true to claim that he was a weak and sickly person. Yet that impression is so much created by Miss Rukeyser that one reviewer says of him that he prob-

ably would have found it difficult to drive a nail straight or hang a picture. This is entirely untrue—Gibbs had useful hands, but we all have heard of the fable of the three black crows! Truth grows by the application of controlled imagination, and untruth by imagination uncontrolled.

It was my privilege as a young man to become acquainted with a considerable number of distinguished scholars of the generation of Willard Gibbs who seemed to me to be much alike in their simplicity, dignity and friendliness—gentleman of the old school we youngsters called them. They did not wish to be hero-worshipped, they were not patronizing, they did not proselytize, they were living examples of what the best in university life has been, is now, and will be so long as there are youth who are inspired by such examples to try to become in all simplicity worthy successors to them.

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REPORTS

WARTIME INVESTIGATIONS AT MELLON INSTITUTE

IN the industrial research proceedings of Mellon Institute during its fiscal year from March 1, 1943, to March 1, 1944, as set forth in the thirty-first annual report of the director, E. R. Weidlein, there are many facts of professional interest. As the following summary reveals, the emergency has raised the levels of investigational capacity and thereby has increased research usefulness.

OUTSTANDING CERAMIC RESEARCH RESULTS

The physical and chemical treatment of gypsum, for its improvement and for obtaining new products, has been given thoroughgoing study during the past five years, with especially valuable results in 1942–3. The use of gypsum in the manufacture of light-weight refractories has been extended. An investigation of mottled or colored silica brick has been described and definition has been made of the effect of furnace gas pressure on the life of refractories. A number of urgent wartime high-temperature problems have been solved by the use of "Carbofrax" and "Monofrax." A new apparatus has been contrived for aging dry cold-set mortars. "Garsand," a novel glass-making material, was introduced. The multiple industrial fellowship on ceramic chemicals has been devoting the full time of its enlarged staff to research on problems in wire-wound resistors. Eight fellowships in all are in the field of ceramics.

ACHIEVEMENTS IN METALLURGY

Many effectual war implements have been formed by metallurgical studies on thirteen fellowships of the institute. Fundamental relations within the foundry cupola have been examined critically. Iron compacts of improved physical properties are a contribution to powder metallurgy; in addition, a new grade of sponge-iron powder possessing excellent compressibility and uniformity has been developed, several original uses of importance have been devised for iron powder, and the commercial production of silicon powder has been worked out. Desirable physical properties have been imparted to arc-deposited low-alloy steel through the employment of novel slag compositions. The failure of restrained welds and the destructive testing of structural joints, involving special gaskets, have had much attention, and protective coatings for steel storage containers are being investigated. A new flux for silver soldering came into extensive use in war industries and a copper-brazing flux was introduced. Advances were made in chromium plating of tools and gages. Many improvements have been achieved in shell manufacture, mainly in the production and finishing of casings and components. Lock-nut technology has been benefited by fundamental mathematical and physical studies. These results have brought the institute close to the zones of military action. Announcement was made of a differential solubility process for treating waste pickle liquor, and basicity factors were interpreted as aids in evaluating limestones and limes as neutralizing agents.

MUCH IS BEING DONE ON COAL PRODUCTS

Methods have been investigated for improving heating efficiency and for conserving anthracite; better procedures of control and operation have been prescribed for house-heating equipment. Smoke-producing tendencies in coals of various ranks have been under inspection. A large program of research on the hydrogenation, dehydrogenation, oxidation and alkylation of coal products has been widened considerably, and several new catalytic processes are under development. The recovery of low-boiling compounds from coke-oven by-products is an allied project. Physical procedures are being applied experimentally to separating coke-oven gas constituents. A new process of making ethylbenzene has been put in large-scale operation. Another investigation has been concerned with the effect of paraffins on the nitration of toluene. Basic research on the production of phenols is well under way. Another group is working on the separation of cresols and xylenols from their mixtures. New

derivatives of naphthalene are getting much attention. A detailed investigation, both theoretical and experimental, has been carried out on the conversion of ammonium thiocyanate into thiourea. Studies of the rheological properties of bituminous materials have been continued, and the commercial production and utilization of pitch compounds which exhibit improved flow properties have been supervised. Many of these new products have found industrial application as weather-resistant protective coatings for various metals

Helpful Research on Natural Gas and Petroleum

Thermodynamic properties of air, liquefaction and storage of natural gas, and thermal insulation are other programs that are going ahead. Research has also been conducted on various ramifications of natural gasoline utilization. Detailed consideration has been given to the economics of production of relatively low-pressure natural gasolines suitable for use as blending agents with various base stocks in the preparation of high quality motor fuels. Because of increasing markets for many of the hydrocarbon components of natural gasoline, investigations have been carried on to determine the identity and quantity of the individual hydrocarbons contained in natural gasolines. Of special wartime interest has been developmental work along the line of producing with air and natural gasoline an industrial fuel having the characteristics of natural gas; the results have proved so successful that several concerns have installed the simple equipment necessary for utilizing this fuel. In crude petroleum correlation research, characteristic portions have been separated, all below 100° C., and a hydrocarbon correlation index of broad scope is in active preparation. Substantial progress has been made in improving fractional distillation techniques under extremely high vacua. An oscilloscope has been devised for determining the dimensions of oil films. The development of special lubricants for fine instruments has been carried along gainfully; entirely new products with superior properties have been created for the Navy. Close cooperation is continually kept up with governmental agencies having to do with liquid fuels, lubricating oils and hydraulic fluids of all kinds.

Scientific Development of Foods

Seven fellowships pertain to major problems of the food industry. Improvements have been brought about in dehydrating prepared foods. The time needed in drying yeast satisfactorily has been shortened. New knowledge has been gleaned in research on decolorizing adsorbents and a new synthetic granular adsorbent has been evolved for the sugar industry. Another fellowship has prepared a dried molasses. A fundamental investigation of the wheat flour lipolytic system is a project in which significant results have been recorded. Carbohydrate preparations for infant feeding have been studied with medical collaboration. The staling of bread is under research of large scope. Certain protein hydrolyzates have been found promising as food-flavoring agents. Aqueous dispersions of bentonite, added to distillery waste, have been shown to be precipitants of the proteins in easily recoverable form.

Solving War Problems in Textile Technology

Several illustrations may be cited from eleven different programs to bring out how textile chemistry is woven into our military fabric Members of the institute are serving as consultants to the Office of the Quartermaster General in the appraisal of U. S. Army clothing and supplies. Experimental and newly developed items must be subjected to scientifically controlled laboratory and field-use tests; commodity standards and textile specialists from the institute have aided in the planning of these projects and in the analysis of the findings. The weathering of treated fabrics employed as covers over the guns of coastal defenses has been investigated to secure textiles more resistant to sun, salt air, wind and rain. New yarns have been made of soybean protein, alone and with viscose A synthetic textile lubricant has been composed for the woolen industry. Advances have been gained in the processing of animal fibers used in felt and some physical properties have been correlated with felt quality. Machinery for the production of fresh-water pearl buttons has been improved.

Wood Products and Especially Paper

The piles of wood waste which have been accumulating at wood-working mills producing small protective disks for shells will become a valuable material for making these disks in consequence of studies carried out on the utilization of such waste. Research on lignin degradation products has been advanced. Progress has been realized toward the development of an integrally greaseproof and waterproof carton stock at economic price by elimination of some of the objectionable features associated with such stock in the past. The war's exacting demands for technical paper of many types have necessitated concentrated work on improving strength and durability as well as finding satisfactory substitute raw materials for manufacture. The possibilities for these improvements have been increased by the development of high polymers and other chemicals. GR-S latex has been applied commercially to the saturation of sulfite papers, with

results indicating satisfactory comparability with rubber-latex treated papers but with somewhat less tensile strength.

Pathfinders of Progress in Plastics

The institute's plasticians have maintained their master researchmanship on twenty-four diverse fellowships. Growing attention to cyclopentadiene in the synthetic plastic and organic chemical fields has greatly stimulated research on methods for its utilization. In action is a study of the electrolytic preparation of certain organic compounds of relevance in the manufacture of synthetic resins, rubbers and fibers. A completed two-year investigation has yielded a new curable liner for container closures. Continued research on resin-pulp products has led to further applications for pre-formed materials. The use of new vulcanizable elastomers and low-temperature curing resins has likewise brought advances in the field of cellulosic molding. Organic salts of hydrous aluminum silicates have been studied with reference to their employment as plastics. The development of military and industrial applications of leather-like plastics, announced a year ago, has been extended. Artificial filaments of various types are receiving long-range research. The synthesis of morpholinomethyl derivatives of ureas has been published. New techniques have been introduced for the preparation of vinyl-resin coating compositions; ketones have been described as solvents for those resins.

W. A. Hamor

(To be concluded)

SPECIAL ARTICLES

THE RELATOINSHIP OF LYSOZYME TO AVIDIN[1,2]

From hen's eggwhite two seemingly unrelated biological principles have been obtained, lysozyme and avidin. Lysozyme is a basic protein[3,4] which lyses susceptible microorganisms like *Micrococcus lysodeikticus* or *Sarcina lutea* by depolymerizing and hydrolyzing a mucoid contained in the bacterial membrane[5,6]; while avidin is said to be a basic protein[7] which combines stoichiometrically with biotin, thus depriving the test microorganisms[8] or the animal[9] of this essential vitamin. Some of the reported chemical properties of avidin were so similar to those of lysozyme that we undertook the study of their relationship, although Woolley and Longsworth[7] reported their avidin preparation free of lysozyme activity.

Seven avidin preparations[10] were tested for lysozyme activity against *M. lysodeikticus* and two strains of *S. lutea*. Avidin activity, varying from 60 to 5,200 units per gm, was proportional to lysozyme activity, varying from 4 to 160 units per mg.

The action of biotin[11] on the lytic action of lysozyme was then tested. In these tests acetone dried *M. lysodeikticus* were used, suspended in M/15 KH_2PO_4, corresponding to a density of a No. 10 $BaSO_4$ standard. With live organisms in 0.9 per cent. NaCl the activity is about double It is known (see review[12]) that the organisms do not dissolve in acid solution, although lysozyme activity is optimal at an acid pH. To demonstrate visible lysis a drop of N NaOH is added at the end of the experiment (usually 1 hour at 37° C.) to stop enzyme activity and to observe clearing of the suspension. The controls without lysozyme are not affected by this treatment

It can be seen from Table 1 that addition of 10 γ

TABLE 1

Lysozyme preparations	Lysozyme units per mg		*M. lysodeikticus*
	Without biotin	With 10 γ biotin	
Avidin (5200 units/gm)	640	2,000	Living
85 B	2,600	164,000	Living
85 C	1,300	164,000	Living
85 C	640	164,000	Acetone dried
85 C	16	2,000	Acid acetone extracted
85 C	640	164,000	Acetone dried
97 C	1,300	20,500	Acetone dried
97 D	640	5,000	Acetone dried

of biotin increases the activity of lysozyme, both against live and acetone-ether killed and extracted organisms, from 8 to 250 times. The effect of 10 γ of biotin is even more marked if incomplete lysis

[1] From the Department of Ophthalmology, College of Physicians and Surgeons, Columbia University, and the Institute of Ophthalmology, Presbyterian Hospital, New York.

[2] The author is greatly indebted to William L. Laurence for suggesting experiments on the relationship of avidin to lysozyme, and to Miss Anita Steinberg for assistance in this work.

[3] K. Meyer, R. Thompson, J. W. Palmer and D. Khorazo, *Jour. Biol. Chem.*, 113: 303, 1936.

[4] E. P. Abraham, *Biochem. Jour.*, 33: 622, 1939.

[5] K. Meyer, J. W. Palmer, R. Thompson and D. Khorazo, *Jour. Biol. Chem.*, 113: 479, 1936.

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[9] P. György, C. S. Rose, R. E. Eakin, E. E. Snell and R. J. Williams, Science, 93: 477, 1941.

[10] We are indebted to Dr. Vincent du Vigneaud, of Cornell University Medical College, and to Dr. H. M. Wuest, of Hoffmann-La Roche for the samples of avidin.

[11] The generous gift of synthetic crystalline biotin by Dr. D. F. Robertson, of Merck and Co., is gratefully acknowledged.

[12] R. Thompson, *Arch. Path.*, 30: 1096, 1940.

(+++) is taken as the endpoint. The activity then increases, for example, from 20,500 to 10,500,000, that is over 500 times.

In Table 2 the influence of increasing biotin concentration on the lysis of acetone dried *M. lysodeikticus* is shown.

TABLE 2

Biotin concentration in micrograms	Lysozyme units per mg
0	640
0.01	610
0.1	2,000
1.0	5,000
2.0	5,000
4.0	10,000
6.0	41,000
8.0	82,000
10.0	164,000

The data reported here can not be explained with certainty at the present time. In analogy with many other enzyme systems, biotin might be considered as the prosthetic group of a protein carrier. This protein carrier would bind biotin, while the biotin-avidin complex would have lysozyme activity. In accordance with this hypothesis is the fact that avidin contains both free avidin and an avidin-biotin complex.[13] However, all attempts to dissociate lysozyme into carrier and prosthetic group have failed so far. These attempts included dialysis in acid and alkaline solutions and electrophoresis. The preparation migrated cathodically at pH 7.80 with a sharp boundary ($u = +6.75 \times 10^{-5}$, Dr. D. Moore). It had an activity greater than 1,000 units per mg. The increasing activation of lysozyme with increasing biotin concentration may contraindicate a simple coenzyme effect of biotin, since the concentration of biotin is far greater than that of lysozyme. The biotin effect, however, apparently is not due to action on the test organisms, since it varies in extent with different preparations of lysozyme.

Aside from any hypothesis, however, the experiments reported in this paper definitely link biotin with lysozyme, a mucolytic enzyme concerned with defense against bacterial invasion. It remains to be seen whether a similar relationship holds true for other enzymes of this important group. It might be pointed out further that an enzyme with the bacteriological specificity of eggwhite lysozyme occurs in many if not in all lysozyme susceptible organisms.[5,12] Similar enzymes with other specificities have been demonstrated in many microorganisms. Such enzymes, which in high concentration partly or completely lyse the organisms from which they are derived, are probably concerned with bacterial multiplication.

KARL MEYER

[13] P. György and C. S. Rose, SCIENCE, 94: 261, 1941.

ON THE POSSIBLE IDENTITY OF "AVIDIN"[1] AND EGGWHITE LYSOZYME

COMPARATIVE studies on "avidin"[2,3] and eggwhite lysozyme[4] bring to light a number of common physical and chemical characteristics. Both seem to be present in the same fraction of raw eggwhite in the same relative abundance. Both have been concentrated by similar chemical procedures. The more similar procedures, *i.e.*, those of Meyer *et al.* for eggwhite lysozyme[4] and of Woolley and Longsworth for "avidin,"[3] have also yielded concentrates of qualitatively similar chemical elements, while the quantitative differences could be accounted for by the seeming differences in the degree of purification. Furthermore, the concept of "avidin" as "antibiotin" makes it difficult to reconcile the fact that whereas biotin is found in so many divergent organisms and tissues, "avidin" has hitherto been found only in whites of eggs or in the oviduct of certain species of frogs and fowl.[5] Moreover, the history of biotin, which was found to be identical with coenzyme R and vitamin H, further suggested that "avidin" may also be a more widely distributed substance.

These considerations led to a series of experimental procedures in which (A) a sample of known eggwhite lysozyme, prepared by Dr. Karl Meyer in October, 1937,[6] was subjected to the standard yeast test[7] for "avidin" activity, and (B) samples of "avidin" of known varying potencies,[8] prepared by Hoffmann-La Roche, Inc., were tested for lysozyme activity.[9]

All tests for both (A) and (B) proved strongly positive, and, furthermore, showed that the "avidin" activity in each "avidin" concentrate closely paralleled its lysozyme activity. The results in the (A) series of tests are shown in Table 1.

[1] The term "avidin" as used here refers to concentrates containing both "free avidin" and avidin-biotin complex.

[2] R. E. Eakin, E. E. Snell and R. J. Williams, *Jour. Biol. Chem.*, 140: 535, 1941.

[3] D. W. Woolley and L. G. Longsworth, *Jour. Biol. Chem.*, 142: 285, 1942.

[4] K. Meyer, R. Thompson, J. W. Palmer and D. Khorazo, SCIENCE, 79: 61, 1934; *Jour. Biol. Chem.*, 113: 303, 1936; *ibid.*, 113: 479, 1936.

[5] R. Hertz and W. H. Sebrell, SCIENCE, 96: 257, 1942.

[6] The author is deeply indebted to Dr. Meyer for supplying him with this sample.

[7] E. E. Snell, R. E. Eakin and R. J. Williams, *Jour. Am. Chem. Soc.*, 62: 175, 1940.

[8] Supplied through the courtesy of Dr. H. M. Wuest, of Hoffmann-La Roche, Inc., and Dr. Ira I. Kaplan, of Bellevue Hospital, New York City. The initial sample tested had a potency of 2,000 units per gm.

[9] The author hereby wishes to acknowledge his debt to Dr. Gustav J. Martin, of the Warner Institute for Therapeutic Research, New York City, for his invaluable assistance in carrying out the experimental work on the "avidin" activity of lysozyme, and to Dr. Meyer, who carried out the tests on the lysozyme activity of "avidin." Dr. Meyer will present his data on these tests, as well as on further tests initiated by himself, in a separate communication.

TABLE 1

"AVIDIN" ACTIVITY OF EGGWHITE LYSOZYME AS COMPARED WITH AN "AVIDIN" CONCENTRATE OF 50 UNITS PER GRAM (S.M.A.)

Tube No.	Biotin (milli-gammas)	S.M.A. Avidin concen. 50 units per g	Lysozyme	Control	Galvanometer reading density
1	50	..	..	√	100
2	50	..	.	√	98
3	50	1 mg	.	..	87.5
4	50	5 mg	.	..	26.00
5	50	..	1 mg	..	56.0
6	50	..	2.5 mg	..	17.5

The data thus show an "avidin" activity of about 100 units per gram for the lysozyme sample. Notice must also be taken of the fact that this sample had been kept for nearly six and a half years at room temperature, which makes it probable that it had lost some of its "avidin" activity, since György *et al.*[10] have observed that whereas the avidin-biotin complex resists the action of digestive enzymes and is also stable to treatment with acid, solutions of "avidin" are slowly destroyed. However, the sample tested had been kept in the form of a dry powder.

The data on the interchangeable activities of "avidin" and lysozyme, along with the data obtained by Meyer[11] strongly suggesting that the lysozyme activity of "avidin" concentrates is due to the avidin-biotin complex, place "avidin" in a new light and promise to provide explanations for certain characteristics that have hitherto appeared paradoxical. Thus, György's observations that "avidin" was "toxic" when given orally, while it was therapeutic when administered parenterally,[12] must now be considered in the light of the present findings, which indicate that "free avidin," rather than being "anti-biotin," more likely serves as a biotin-carrier and thus may be more properly termed a "pro-biotin," its so-called "toxic" effect being due to other reasons, such as molecular size, resulting in its non-absorption from the gastro-intestinal tract.

The data reported here, as well as the data obtained by Meyer, point to the need of a thorough reexamination of the literature on lysozyme from various sources that has appeared since its discovery by Fleming in 1922,[13] and also of the literature of other seemingly related products of bacterial and animal origin, such as the various forms of hyaluronidase and "spreading factor."[14] It may be useful at this time to propose as a working hypothesis that "free avidin" is a member of a group of related substances acting as carriers in a system of enzymes in which biotin serves as the prosthetic group.

WILLIAM L. LAURENCE

[10] P. György, C. S. Rose and R. Tomarelli, *Jour. Biol. Chem.*, 144: 169, 1942.

[11] K. Meyer, Personal communication.

[12] P. György and C. S. Rose, SCIENCE, 94: 261, 1941.

[13] R. Thompson, *Arch. Path.*, 30: 1096, 1940.

[14] K. Meyer, E. Chaffee, G. L. Hobby and M. H. Dawson, *Jour. Exp. Med.*, 73: 309, 1941.

THE TOXICITY OF ORALLY ADMINISTERED TANNIC ACID

SEVERAL reports,[1, 2, 3] inspired by the use of tannic acid in burn therapy, have recently appeared describing the hepatotoxic effects of tannic acid. Baker and Handler[1] observed striking hepatic necrosis in rats within 48 hours after tannic acid was either painted on an area denuded of skin or injected subcutaneously. It seemed of interest to determine the effects, if any, of orally administered tannic acid.

The diets used and the results are summarized in Table 1. Twelve rats of the Vanderbilt strain were employed in each group. All animals weighed between 50 and 60 grams initially and the experiments were conducted for 90 days.

TABLE 1

Group	Diet	Final weight	Hepatic damage
1	Ground Purina Chow	240	0
2	" " "	180	0
3	" " " + 1 per cent tannic acid	188	0
4	" " " + 2 " " " "	169	0
5	Synthetic ration[4]	197	0
6	" "	173	0
7	" " + 1 " " " "	169	0

The animals in group 2 were pair-fed with those in group 3 and those in group 6 with group 7. The deleterious effect of tannic acid on rat growth appeared to be only due to the animal's dislike for the diet. After 90 days the animals were sacrificed by decapitation and liver specimens from each group were taken for histological examination. In no instance was there evidence of the hepatic necrosis described previously. The gastrointestinal tract appears to be completely impermeable to tannic acid since during the course of the experiment the animals in groups 3 and 7 ingested 100 times the amount of tannic acid which, given subcutaneously, invariably produced hepatic necrosis. The innocuous results of tea drinking, by man, are in accord with these findings.

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[1] Roger D. Baker and Philip Handler, *Ann. Surg.*, 118: 417, 1943.

[2] F. W. Hartman and H. L. Romence, *Ann. Surg.*, 118: 402, 1943.

[3] D. B. Wells, H. D. Humphrey and J. J. Coll, *New Eng. Jour. Med.*, 226: 629, 1942.

[4] The synthetic ration was casein 20, cottonseed oil 15, cod liver oil 5, salt mixture 5, sucrose 55. To each kilogram of this diet were added thiamine 2.5 mg, riboflavin 5 mg, pyridoxine 2.5 mg, calcium pantothenate 40 mg, choline chloride 200 mg.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A METHOD FOR PREPARING PERMANENT SLIDES OF THE OVA OF PARASITIC WORMS

THE aqueous media commonly used to prepare microscopic slides of ova of parasitic worms give rather fragile preparations which withstand classroom use poorly.[1] Yet these specimens must be mounted in water-soluble materials because dehydration and "clearing" either distort them beyond recognition or render them invisible.

In a limited series of tests of available water soluble substances that might be used with some hope of improving durability of mounts, one formula of the gum acacia-chloral hydrate medium[2] has given satisfactory results, when used as indicated by the following directions.

(1) Prepare a series of dilutions of gum-chloral in 10 per cent. formalin starting with a 10 per cent. solution and increasing concentrations by 2 per cent. for each subsequent step, or make up each dilution as it is needed.

(2) Concentrate fecal suspensions that have been thoroughly fixed in neutral formalin until each drop of fluid contains 10 to 12 ova. Each cubic centimeter of this will yield about 10 slides.

(3) Pipette 5 cubic centimeters of the concentrated fecal suspensions into vaccine bottles of 15 cubic centimeter capacity. Next add an equal quantity of 10 per cent. gum-chloral-formalin, tilting the bottles to allow this fluid to run in along the lower side. In all dilutions of the series, gum-chloral is heavier than any fecal suspension tested and will occupy the lower half of the column of fluid. Do not shake the bottles or stir the contents.

(4) Cap the bottles and leave them at room temperature or in an incubator at 37° C. until the fecal material has completely settled. Then remove the clear fluid above the feces with a fine-pointed pipette attached to a vacuum pump, and add an equal volume of the next higher concentration of gum-chloral solution.

(5) Continue this process until the ova are suspended in full-strength gum-chloral medium. When the last sedimentation is complete and excess fluid removed, mix the contents of each bottle thoroughly before starting to prepare mounts.

(6) Use clean slides and cover glasses. Circular cover glasses 12 to 15 millimeters in diameter give better mounts than larger sizes. Squares are unsatisfactory for most specimens. Mounts are prepared by two persons working as a team; one transfers drops of the mixture to the slides, the other adds the cover glasses. With some practice one will come to judge the size of drop which will spread completely under the cover glass without excess. For transferring the material to slides, a heavy platinum loop about 4 millimeters diameter is superior to a pipette. The loop delivers a drop of about the correct size with few air bubbles. Cover glasses must be applied quickly to the mounts. Otherwise the medium hardens and spreads poorly.

(7) Dry the mounts in a horizontal position in an incubator at room temperature. Any air bubbles under the cover glass usually are extruded during drying. Thereafter, slides may be treated as if prepared with balsam or clarite. The medium is readily soluble in water, however.

This schedule requires several months for completion, but actually the time given to the specimens is only the matter of minutes for each change of solution. Results amply compensate for the effort. By this method I have prepared mounts of the ova of *Schistosoma mansoni, Clonorchis sinensis, Fasciola hepatica, Diphyllobothrium latum, Hymenolepis nana, Taenia saginata, Ascaris lumbricoides, Trichocephalus trichiurus* and *Enterobius vermicularis*. In these slides small numbers of the ova of some species are distorted, but the majority remain intact and are seen in greater detail than in temporary mounts of formalin-fixed feces. The only failure thus far has been with hookworm eggs, all of which became badly distorted.

Adult *Necator americanus* and other small nematodes, mites, ticks, lice and the larvae and pupae of flies are easily infiltrated and mounted by this method. These organisms remain soft and are easily arranged on slides. When mounted under small round cover glasses, supports do not seem to be necessary.

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THE BIOLOGICAL LABORATORY AT COLD SPRING HARBOR[1]

By ROBERT CUSHMAN MURPHY
PRESIDENT, THE LONG ISLAND BIOLOGICAL ASSOCIATION

THROUGHOUT more than a half a century the Biological Laboratory has been fortunate in the character, even more than in the number, of its friends. These fall into two groups, one made up of men and women professionally devoted to scientific careers, who have studied, taught, attended the Symposia or conducted research at Cold Spring Harbor. Many of these maintain their membership in the association, even though they reside in educational communities scattered all over the United States or in foreign lands.

The second comprises neighbors (in the sense that they are chiefly Long Islanders), who represent public-spirited and enlightened sentiment in the area.

The two classes overlap, of course. Within a few weeks we have lost a distinguished man who belonged to both, and who for fifty years had been in many ways the first of our friends and builders, namely, Dr. Charles B. Davenport. You will remember also that his son-in-law, Dr. Reginald G. Harris, was director of the laboratory until his death, and that all other members of his family have been closely tied up with the growth of our institution. Many of you knew Dr. Davenport so well that no words of mine could enhance your appreciation. We have endeavored to crystallize our joint thoughts in a resolution which appeared in SCIENCE of March 10, 1944.

Nothing in human affairs is more satisfactory than a tradition of sound heads and large hearts. It is an inspiring experience to look back through the annual reports of many years and to read the names of the men and women of science and of national and world affairs who have given time, energy and judgment toward the advancement of our work. Happily, some of those from the early days are still working with us, and others, such as Mr. Russell C. Leffingwell, Mr.

[1] Address at a winter meeting of the members of the Long Island Biological Association, held at the residence of Mr. and Mrs. Russell C. Leffingwell in New York City, March 21, 1944.

Henry L. Stimson and Professor H. E. Walter, carry the badge of the old relationship through election to the post of director emeritus.

Dr. Demerec, director of the laboratory, has just given us a memorable account of its importance in relation to victory. If it had no other value than this essential one during a period of national crisis, it would justify all the work and other wealth that have ever been put into it. Because modern war involves not only armies but also everybody else—the helpless along with the combatants it is no longer practical to count on "getting ready" when the blow falls. That is the way to defeat and to a lost cause. Rather, we have to "keep ready," and the existence of such an institution as ours, with its corps, its equipment and its status as a going concern, is an important item in that plan.

In fact, if we search for a single field in which our country has had an advantage over all its enemies, we find it in the number of thoroughly trained scientific minds of the highest quality, and in the sufficiency of tools by means of which the varied research of such minds is carried out. It would be impossible to overestimate the brilliance and diversity and effective organization that civilian science is contributing to the struggle in which we are all engaged. Without that concentrated skill and triumphant devotion to a common end, neither military nor industrial genius could have brought us as far along the road as we have come. It is safe to say that never in history has science been called upon for such a vast and coordinated piece of team-work within so short a period.

Happily, however, there is no need to point to war in order to justify our place in society. Peace is our true medium. We hope that when it spreads its light again we may never see the end of it. Our real program is a long-term affair; our aims lie in pure research rather than in fields that even border on industrial research. The practical applications come anyway, but the goal is simply truth. Science is in complete accord with at least one avowal of religion, namely that the truth will make us free. Last year, Dr. Demerec quoted in his report on research the following apt paragraph from the annual review by President Raymond B. Fosdick of the work of the Rockefeller Foundation.

> We must of necessity serve the war effort, for there is no future for what we most desire in a world dominated by fascism. But we have a responsibility equally compelling to preserve the treasures of the spirit which we hold in trust from the past for the benefit of the generations to come. There must be no broken link in the chain, no flaw in the title deeds by which what we most cherish is transferred to the future.

The restrictions of the present "gasolineless" times, which prevent our members from coming to the laboratory with their former freedom, fortunately coincide with the fact that we are not at the moment able to do justice to visitors. Much research of a highly confidential nature is in progress at Cold Spring Harbor. A temporary change of régime has been necessitated by the war Even the "Symposia on Quantitative Biology," instituted by Dr. Harris in the summer of 1933, have had to terminate for the present. At least, they were not allowed to peter out They ended in a blaze of glory in the Symposium on "The Relation of Hormones to Development," attended by 117 individuals, including representatives from Canada and from Chile, at the opposite ends of the Americas. When victory has been won, the Symposia will be resumed

The ten published volumes of the Symposia are a noble scientific record. They are not light reading; as Mark Twain once said about something else, you might have difficulty in following the plots of some of the stories. They deal with such subjects as protein structure, bioelectric problems, radiation, growth and decay, the origin and functions of hormones, viruses, oxidation systems, the physics and chemistry of blood cells and the genes and chromosomes. They are evidence that now, as always in the past, the laboratory has kept in the forefront of significant biological trends

If you want a sign of truly critical approval of recent activities of the laboratory, it is to be found in the attitude and actions of the foundations. They are proverbially hard-headed organizations, quite beyond favor or cajolement. Some of them list in their annual reports not only the pleas they have granted, but also the many worthy causes to which aid has had to be denied. Even to be listed among the unsuccessful applicants is an honorable estate! Lack of success by no means reduces them to the status of the candidate for a job in India, who cited as a high recommendation the fact that he had "failed entrance to Calcutta University"

But the foundations have not turned down the special needs of our laboratory. On the contrary, they have treated us through the years with conspicuous generosity. The Rockefeller Foundation, responsible for financing our Symposia, has recently joined with the Carnegie Corporation in enabling us to purchase on highly favorable terms a priceless parcel of land including the former residence of Mrs. Henry W. de Forest. This acquisition, now the home of our director and his family, together with the antecedent gift from Mrs. de Forest of the famous Sand Spit and of nine acres of harbor shore and upland, have enormously enriched the permanent outlook of the laboratory.

While speaking of the Carnegie relationship, which has been for many years so close that we make up practically one Cold Spring Harbor family, I may

remind you that it is the Carnegie Institution of Washington which lends us, by the year, the services of our director, Dr. Millislav Demerec.

My membership in the board of this association, which is a very great honor, is of only a few years' standing. But my relationship with the laboratory has grown to be an old story. I want for the moment to jump back nearly forty years in order to explain what the laboratory means to me, and what it does or may mean to many of the rest of us.

In the summer of 1907, the International Zoological Congress met for the first time in America. I was then spending a year at the American Museum of Natural History, before going to college, and I had the good fortune to be attached as a sort of aide-de-camp to several of the visiting scientific men from continental Europe. This gave me a profound feeling of importance, together with an opportunity to partake of all the free food and transportation provided for our guests. We invaded Cold Spring Harbor in force on what was the first visit for most of the foreign gentlemen as well as for myself, and proceeded to dispose of a gargantuan clam-bake. The occasion gave me visual proof of the valor of Englishmen, which has served them so well from the year 1066 to the present. It was demonstrated by the manner in which the professors from that country tackled steamed clams, corn on the cob, watermelon and various other products of this wild aboriginal land that they had never before seen. At the end of the orgy, the shells, shucks, husks and carapaces piled in front of each satiated man of science bulked about one cubic meter!

To cap the climax, one of the central European visitors joyfully announced that he had seen his first "Kolibri," by which he meant a ruby-throated hummingbird paying a visit to Mrs. Davenport's trumpet flowers.

The laboratory was a simple institution in those days, at least by comparison with the advantages we now possess. It had been founded seventeen years earlier, at a low economic ebb of the community following the end of the whaling era and of the manufacturing that once flourished in Cold Spring Harbor. Such subjects as invertebrate zoology had not yet given way to biophysics, genetics and experimental endocrinology, with all their formidable apparatus. Yet I can remember how greatly I was impressed by the prestige that the laboratory enjoyed among our noted visitors from all quarters of the globe. It is easy to understand this in retrospect because, even before that date, intensive studies of the life of the Sand Spit had carried the fame of Cold Spring Harbor into classrooms everywhere.

No doubt, moreover, much of the later work of the laboratory has made louder echoes at a distance than close to home. It is the same old handicap, affecting the rôle of the prophet in his own country. The laboratory has been supported mainly by a closely knit group of Long Island neighbors, yet its reputation may be greatest in San Francisco or London or Naples or Stockholm.

In the 1941 Annual Report, it was pointed out that our institution is only one year younger than the Marine Biological Laboratory at Woods Hole. A roster of the instructors, investigators and participants in scientific conferences at Cold Spring Harbor would include a large proportion of the outstanding American biologists of the past half century. Approximately 2,500 of them have received part of their training at our plant

So, all in all, we have a lofty heritage. Who are they that will accept it and pass it along as a dynamic asset to succeeding generations? It is the future that should now claim our concern. While the war lasts, Mars—as always—will find means to keep his helpers going, but the god of war makes no provision for what follows.

Neither can we look to the foundations for our general needs, because their function is rather to nurture the infant idea and to carry it along until its bones harden, after which it must toddle on its own legs and prove that it is worthy to grow up.

Nor, in my opinion, does it profit us to think in terms of a great endowment. To-day there are serious doubts about the future adequacy of invested funds belonging to institutions thousands of times richer than we can ever hope to be.

No, it is as a membership body that this association is to sink or swim. We welcome our affiliates without reference to their geographic ties, but it seems to me that Long Island is our natural field, particularly as regards laymen. Surely there are enough potential friends in that area to carry the laboratory program superbly at imperceptible sacrifice. A thousand new small annual contributions would be worth more to us in the long run than a single gift representing the same total.

What we all hope to see on Long Island is a great burgeoning of proprietary interest in the laboratory, so that the residents of Smithtown, Greenport, Orient, Montauk, the Hamptons, Riverhead, Ronkonkoma, Islip and Cedarhurst—not forgetting Patchogue, Aquebogue, Nissiquogue, Cutchogue and just plain Quogue—may feel that it belongs to them no less than to the generous folk of the nearby communities who have proudly carried the standard through so many fruitful years.

DIET AND DISEASE IN THE BANTU

By CHRISTINE GILBERT and Dr. JOSEPH GILLMAN

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THE incidence of disease in the Bantu (South African Negro) has long been known to be very different from that usually described for the Whites or Europeans in South Africa. Cirrhosis of the liver is found in four out of five autopsies performed on male Bantu at the Johannesburg General Hospital.[1] Gallstones and diabetes are rare diseases,[2, 3] while peptic ulcer in the rural Bantu population is almost unknown, but in a series of over 12,000 autopsies it was found to be seven times higher in the whites than in the urban Bantu.[4] Endocrine disorders affecting the pituitary and the thyroid are extremely rare, although colloid goiters are endemic in some areas of this country. Kidney stones in the Bantu are pathological curiosities.[5] Tuberculosis is extremely widespread and almost every second case admitted to hospital dies. Enlarged prostates are infrequent events, but sterility is not uncommon. The most remarkable discrepancy, however, is in the incidence of cancer. On the Witwatersrand Gold Mines, amongst the Bantu recruited from the native territories and Portuguese East Africa, primary carcinoma of the liver, a rare disease in Europeans, accounted for 90.5 per cent. of all cases of cancer. In the urban Bantu population, however, primary carcinoma of the liver was found almost exclusively in young male adults among whom it accounted for 31.9 per cent. of carcinoma of all organs, whereas cancer of the stomach was relatively common amongst males, especially after middle age. In the female, carcinoma of the genital system was responsible for almost 75 per cent. of cancers affecting all organs. Cancer of the stomach is unknown, but urinary bladder cancer is occasionally found.[6]

While it would be easy to attribute this peculiar incidence of disease in the Bantu to a racial factor, it seemed probable that the economic backwardness of the Bantu people might be an equally important factor which could not be overlooked. In 1936, 55 per cent. of wage-earners of all races, of which the Bantu constituted 90 per cent., earned between £9 and £36 (between $36 and $150) per annum. Only 4 per cent. of wage-earners had an income of $600 to $1,000 per annum.[7] In view of this meager wage, the Bantu people are constrained to live almost exclusively on the cheapest available carbohydrate—in this case—corn (maize or mealie meal). This food is partly cooked, and in some areas it is supplemented by fermented cow's milk. Meat is a luxury and is eaten only on ceremonial occasions or when their cattle or sheep die from disease or starvation.[8] It is a natural consequence that deficiency diseases of all kinds, including pellagra, are widespread amongst the black people in South Africa.

In order to ascertain with greater precision the effect of diet on the incidence of disease in the Bantu, it was felt to be of fundamental importance to discover the reactions of laboratory animals fed on corn pap and sour milk. For this purpose, 125 albino rats of the Lister strain and weighing between 40 and 55 gms were fed on liberal quantities of corn pap and fermented milk for a period of two years.

Careful records of the weights of the control rats, fed on a mixed diet, and of the experimental rats showed that at the end of three weeks the control animals had doubled their weights, whereas the experimental rats had not doubled their weights even at the end of seven weeks.[9] At the end of five months, apart from the retardation in growth, there were no gross external abnormalities, except that the coats of some animals assumed a pale rusty color. After 15 months, many rats had lost all their hair, especially in the lower abdomen and over the thighs and back. The majority developed a brown incrustation over the whiskers, around the eyes and the snout. Rats on a normal diet show by slit-lamp microscopy a clear cornea with glistening epithelium. Those on an abnormal diet have pathological lesions in the cornea which take the form of irregular blistered epithelium with evidence of scarring. The transparency of the cornea is further reduced by the ingrowth of capillaries which form a network in the corneal substance. Dental lesions were of frequent occurrence; this expressed itself chiefly in the form of irregular growth of the incisors, some of which grew either into the lower jaw or the top jaw. In one instance only did the incisors lose their orange-red color. In one rat, a hemorrhage occurred into the anterior chamber of the eye. In a few instances, the females gave birth to five or six young, but these were never reared.

[1] A. Sutherland Strachan, personal communication.

[2] C. F. Beyers, *Jour. Med. Asn. S. Afr.*, 1: 606, 1927.

[3] Joseph Gillman, *Am. Jour. Phys. Anthrop.*, 21: 131, 1936.

[4] P. C. Eagle and Joseph Gillman, *S. Afr. Jour. Med. Sci.*, 3: 1, 1938.

[5] V. Vermooten, personal communication.

[6] C. Berman, *S. Afr. Jour. Med. Sci.*, 1: 12, 1937; *ibid.*, 5: 54 and 92, 1940; *ibid.*, 6: 145, 1941.

[7] John Burger, "Black Man's Burden" (Gollancz, London), 1943.

[8] R. Smit, personal communication.

[9] C. Gilbert, J. Gillman, J. Mandelstam, T. Gillman and L. Golberg, *S. Afr. Jour. Med. Sci.*, 1943.

The organs most profoundly affected were the liver, lungs, testes and adrenals. Without exception, the animals developed liver lesions which varied from a marked fatty change to multi-lobular cirrhosis. Frank cirrhosis occurred in 20 per cent. of rats and affected almost exclusively the left lobes, while the right lobes underwent marked hypertrophy and were fatty. This liver damage in the rat was not without some interest in view of the high incidence of liver cirrhosis in the Bantu.

Lung lesions occurred in the majority of rats and they were chiefly lung abscesses and bronchiectasis.

The testes in all male rats were damaged to a greater or lesser extent. They were soft and, on section, oozed fluid. Giant cells were commonly found, and in one testis associated with complete tubular degeneration a nodule of interstitial cells had developed and, on cytological examination, appeared to be malignant. The prostate and seminal vesicles associated with the atrophic testes were reduced in size. It is worthy of note that the majority of Bantu patients suffering from cirrhosis of the liver had lost their sexual appetite.

The suprarenals presented a variable picture. In the majority of rats, the adrenals were enormously hypertrophied and in five instances adrenal hemorrhage was obviously the cause of death. Hemorrhage occurred only in the left adrenal. In the remaining animals, the adrenals were small and of a gray color.

The thyroid gland was atrophic while the parathyroids were invariably enlarged. The parotid gland and the pancreas did not escape injury. The parotid was always damaged, while the pancreas was affected in only 56 per cent. of cases. In the parotid there was no evidence of metaplasia, but the whole architecture of the gland was profoundly disturbed. The nuclei were extremely enlarged and showed cell degrees of anaplasia. Frequently a single cell contained 6 to 8 giant nuclei, each measuring in some instances as much as 40 microns. The lesion in the pancreas was different from that in the parotid. The granules disappeared from the acinar cells, and those later lost their spheroidal appearance and became arranged in the form of small dilated ducts. These aggregations of ducts were scattered throughout the pancreas and they could be seen with the naked eye as rather white opaque spots no larger than a pin's head.

Enlargement of the heart was found in those rats whose livers were severely damaged, and in two instances the endocardium of the enormously enlarged ventricles was found to be calcified throughout its extent. Cirrhosis of the liver was less common in females and dead embryos were not infrequently found in the uterus. It might be mentioned at this stage that although the skull was very thick, the bone cut easily.

It is thus seen that during the first nine weeks the feeding of corn pap alone leads to an arrest of growth, there being a gain of only 7 to 10 grams. While the addition of fermented milk definitely speeds up growth, it invariably causes the animal to develop extensive lesions, including a damaged liver. In young rats (40 to 50 gm) the livers begin to show fatty change at the end of 20 days, but these do not become very marked until the end of 150 days.

It was impossible to attribute the lesions in the rat to the absence of any specific vitamin. It is true that the testicular damage and the dead embryos in the uterus could be regarded as a manifestation of vitamin E deficiency, but it is very likely, too, that vitamin E deficiency would also be regarded as an expression of liver damage, since in dogs with biliary fistulae Brinkhous and Warner[10] have described the presence not only of muscular dystrophy simulating vitamin E deficiency, but also lesions which could be attributed to a deficiency of vitamins D and K. A damaged liver in the rat also apparently upsets the metabolism of fat-soluble vitamins, although there was no evidence of vitamin K deficiency. The occurrence of a malignant hyperplasia of the interstitial cells of the testes in the rat mentioned above is also of interest, since these tumors can be produced in mice by oestrogen.[11] It seems very likely that damage to the liver affects, amongst other things, not only the metabolism of some of the fat-soluble vitamins but also the metabolism of the steroid hormones. The work is proceeding to discover the factor or factors responsible for the various lesions in rats mentioned

This simple experiment reveals the widespread lesions that may result from feeding the common Bantu diet to rats; it throws some light, too, on the problem of the high incidence of liver, lung and heart disease in the black people of South Africa; it also indicates that great caution must be exercised in attributing to a racial factor any differences in the incidence of disease amongst the black and white people.

OBITUARY

JAMES OTIS BEASLEY

The South has lost one of its most valuable agricultural research workers, the nation one of its most promising young cytogeneticists in the passing of James Otis Beasley, who died on September 12, 1943, following wounds received in action in Italy.

Dr. Beasley was born at Wells, Texas, on September 7, 1909. He was educated in the public schools of Texas, graduating from Lufkin High School in

[10] K. M. Brinkhous and E. D. Warner, *Am. Jour. Path.*, 17: 81, 1941.

[11] C. K. Hooker and C. A. Pfeiffer, *Cancer Research*, 2: 759, 1942.

1928, from the Agricultural and Mechanical College of Texas in 1932 and receiving the master's degree from the same institution in 1934. During the next two years he served as an assistant in the Texas Agricultural Experiment Station, engaged in studies upon the morphology of the cotton seed. In 1936 he entered Harvard University as a graduate student, completing the requirements for the doctorate in 1939. During parts of 1938 and 1939 he was employed by the U. S. Department of Agriculture in genetic investigations of cotton at Raleigh, N. C. Since 1939, until he entered military service, he was agronomist and cytogeneticist on the staff of the Texas Agricultural Experiment Station. As a First Lieutenant in the Infantry Reserve he was called into active service on March 5, 1942. Feeling that he might be more useful in the Chemical Warfare Service he was, at his own request, transferred to that branch. He landed in Oran in May, 1943, took part in front line action in the Sicilian campaign and again in the Salerno landing, where he was fatally wounded while leading a small detachment in an attack upon an enemy-held farm house in front of the American lines.

Dr. Beasley is survived by his wife, Dr. Elizabeth Wagner Beasley of Carroll, Ohio, whom he married in 1940, and by his son, John Wagner Beasley, born in 1942.

Since Beasley grew up in a rural community, in a state where cotton is the all-important crop, and since he was by nature a student, it is not surprising that he should have turned his energies at an early age to the study of cotton. As an undergraduate he competed for, and won, a traveling scholarship for the study of cotton, and during the summer of 1932 he visited the principal cotton-growing areas of the United States and the important cotton merchandising and manufacturing centers of Europe. When he entered Harvard as a graduate student, under Dr. E. M. East, he began almost immediately a study of the genetics and cytology of Gossypium species. In spite of the difficulties of growing cotton species in the vicinity of Boston, even in the greenhouse, he succeeded in making considerable progress in a relatively short time.

In his research Beasley showed marked originality not only in devising new methods of attack, but also in adapting the techniques of others to his own problems. By the use of mixed pollinations to prevent the bolls from shedding prematurely and by employing embryo culture techniques, he succeeded in producing species-hybrids not obtainable by ordinary methods. He was one of the first to utilize colchicine extensively in doubling the chromosome number of sterile hybrids to produce fertile allopolyploids. These he investigated cytologically to contribute to an understanding of the origin of cultivated cottons, a subject to which his more important published papers are devoted. He also utilized such hybrids in an attempt to transfer useful genes from wild 13-chromosome species to the 26-chromosome American cultivated cottons. His success at transforming sterile diploids to fertile tetraploids led him to suggest that hybrid vigor in such crops as maize might be perpetuated indefinitely by producing inversions and translocations with x-rays to the point where the F_1 hybrid of two strains should be sterile, then doubling the chromosome number to produce a fertile true-breeding tetraploid hybrid exhibiting the heterosis of the diploid. The proposal, which has never been adequately tested, offers important theoretical possibilities in plant breeding.

Dr. Beasley was an industrious, capable and conscientious scientist motivated by a friendly spirit of cooperation, an intelligent curiosity and an eagerness to contribute to the improvement of cotton and to Southern agriculture in general. For such a task he was superbly fitted both by temperament and training, for he combined to an exceptional degree an appreciation and understanding of the theoretical principles of genetics, with an ability to apply those principles to practical problems of plant improvement. It is difficult to imagine a man of Beasley's type, thoroughly peaceful, scholarly, quiet and reserved, taking kindly to the art of warfare. Yet he was successful as an officer; popular with his men and respected by the officers above him. He has been awarded the Purple Heart posthumously for "military merit" and has been recommended for an additional citation for "continuous devotion to duty." One can not believe, however, that the supreme sacrifice which he was called upon to make as a soldier can compare in effectiveness with the contributions to scientific progress and to human welfare which he almost certainly would have made had his peacetime pursuits been permitted to reach fruition.

P. C. MANGELSDORF

BOTANICAL MUSEUM,
HARVARD UNIVERSITY

DEATHS AND MEMORIALS

DR. DAYTON STONER, since 1932 state zoologist of New York, died on May 8 at the age of sixty years.

STUART BALLANTINE, since 1935 president of the Ballantine Laboratories at Boonton, N. J., known for his work in the field of radio engineering, died on May 7 at the age of forty-six years.

DR. WILLIAM SPENCER CARTER, from 1922 to 1934 dean of the medical faculty of the University of Texas, formerly associate director of the medical sciences of

the Rockefeller Foundation, died on May 12 at the age of seventy-five years.

DR. LOUIS LEROY, professor of the theory and practice of medicine at the University of Tennessee, died on May 9 at the age of sixty-nine years.

MEMORIAL HOSPITAL for the Treatment of Cancer and Allied Diseases, New York City, which is celebrating its sixtieth anniversary, is raising a fund of $150,000 as a tribute to the memory of the late Dr. James Ewing, who was associated with the hospital for thirty years both as president of the medical board and as director. Income from the fund will be used to support the undergraduate and graduate instruction for medical students at Cornell University Medical College and at the hospital, to finance at least two lectures annually on recent advances in neoplastic diseases and to support such special study as may seem advisable to the supervisory committee.

SCIENTIFIC EVENTS

THE INDIA COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH[1]

THE organization of industrial research in India, with a view to making her industrially self-sufficient, has been engaging the attention of the Government of India for some time. An Industrial Research Bureau had been established as a clearing house of industrial intelligence after the Sixth Industries Conference in 1934, but at the outbreak of war many sources of supply of finished products to India were either stopped entirely or much curtailed, and it became apparent that a central scientific and industrial research organization should be established immediately. Thus the Board of Scientific and Industrial Research was set up in April, 1940, for a period of two years in the first instance.

The functions of the board were to advise the Government as to the lines on which scientific and industrial research should be conducted, particularly as regards industries whose importance and possibilities were brought into the foreground by wartime conditions. The board was to utilize and coordinate the work of existing organizations and to make recommendations to the Government concerning the general lines on which industrial research should be pursued, and the specific problems which might be assigned to the technical staff directly under the control of the board, on the one hand, and to the various university and other scientific institutions on the other. The board consisted of four scientists, seven industrialists and one departmental head, with the executive council member in charge of the Commerce Department as chairman. It was to meet every three or four months. Research committees, composed of scientists and industrialists, were set up to examine and report on research schemes and watch their progress. Nineteen such committees were set up in the first two years.

When certain researches had reached a stage at which their commercial exploitation could be considered, an Industrial Research Utilization Committee was formed to settle the terms on which the researches could be released to manufacturers. The committee, consisting mostly of industrialists, was under the board and contained representatives of industries and of the Chamber of Commerce.

In 1942, the Council of Scientific and Industrial Research was constituted to coordinate and generally exercise administrative control over the Board of Scientific and Industrial Research and the Industrial Research Utilization Committee. Its fourteen members are drawn mostly from the board and the committee. The council has been established on a permanent basis and is financed by the Industrial Research Fund, providing in the first instance an annual grant of 10 lakhs of rupees (about £75,000 sterling) for five years.

Since its formation, the board has been mainly occupied with the solution of urgent war problems, but it has devoted considerable attention to the organization of scientific and industrial research on a scale commensurate with India's expanding needs. Plans have already been prepared for establishing a National Chemical Laboratory, a National Physical Laboratory, a Metallurgical Research Institute, a Central Glass and Silicates Research Institute and a Central Fuel Research Station. When these become effective, India will be provided with facilities for research reasonably adequate to meet her immediate requirements.

In order to give publicity to the research activities initiated by or undertaken at the instance of the board, it was decided to publish the *Journal of Scientific and Industrial Research,* the first number of which appeared in October, 1942. Publication is quarterly, and copies may be obtained on application to The Secretary, Council of Scientific and Industrial Research, New Delhi, India.

[1] From the *Journal of Scientific and Industrial Research,* Melbourne, Australia.

THE ESTABLISHMENT OF A DIVISION OF HIGH POLYMER PHYSICS IN THE AMERICAN PHYSICAL SOCIETY

DR. KARL K. DARROW, secretary of the American Physical Society, recently announced that a Division of High Polymer Physics had been authorized by the

council of the society, acting in response to a petition signed by thirty-one fellows and members.

The field of this division is defined as the advancement and diffusion of knowledge of the physics of high-polymeric materials such as rubbers, textiles and plastics. Meetings of the division may be held (if the council so authorizes) in conjunction with or separately from meetings of the society.

The council has appointed an "organizing committee" to take charge of the organization and the affairs of the division until by-laws are formulated and adopted by the council and a mechanism is set up for electing an executive committee. The organizing committee consists of F. G. Brickwedde, K. K. Darrow, G. B. Pegram and A. E. Ruark, selected from the council; and R. B. Barnes, W. F. Busse, P. Debye, J. H. Dillon, W. J. Lyons and L. A. Wood, selected from the members sponsoring the division. W. J. Lyons (Southern Regional Research Laboratory, 2100 Robert E. Lee Boulevard, New Orleans 19, La.) is serving as secretary of this committee.

According to Article IX of the constitution of the society:

1. The council may, upon petition by members of the society, form a division within the society charged with the advancement and diffusion of the knowledge of a specified subject or subjects in physics.
2. Each division shall elect an executive committee, the chairman of which shall report its activities and needs to the council.
3. Any division may be dissolved at the discretion of the council.

THE GEOLOGICAL SOCIETY OF MINNESOTA

THE Geological Society of Minnesota has just ended its most successful year. The society is unique in that most of its members are amateur geologists whose purpose is to study geology and mineralogy for their cultural value. It is an incorporated organization with approximately one hundred and sixty-five active members who, during the months from October to May, meet once a week for a lecture or talk on some geologic subject. The meetings are held in the Science Museum Auditorium of the Minneapolis Public Library. From May until October members endeavor to have a field trip every two weeks. During the year just closed there has been an average attendance of seventy-six members at the weekly lectures.

During each of the last two years a course of sixteen lectures, given by Professor George A. Thiel, of the department of geology of the University of Minnesota, has been sponsored. As a part of the program a bulletin entitled *The Minnesota Geologist*, with items of interest for members, is issued eight times a year.

The society consists of business and professional men and women interested in earth sciences. Officers of the society are Edward P. Burch, *Founder and Counselor;* Charles H. Preston, *President*, and Loretta E. Koppen, *Secretary*.

THE SOCIETY OF THE SIGMA XI

NEWLY elected officers of the Northwestern University Chapter of the Society of the Sigma Xi are: *President*, Professor W. F. Windle, of the School of Medicine; *Vice-president*, Professor F. A. Brown, Jr., of the department of zoology; *Secretary*, Professor Wallace Givens, of the department of mathematics; *Treasurer*, Dr. I. M. Klotz, of the department of chemistry, and *Member of the Nominating Committee*, Professor M. J. Herskovits, of the department of anthropology.

AT a recent meeting of the Rochester Chapter, the following new officers were elected: *President*, Professor R. W. Helmkamp; *Vice-president*, Dr. W. L. Bradford; *Secretary-Treasurer*, Dr. Charles D. Kochakian; *Member of the Executive Committee*, Professor Curt Stern; *Members of the Nominating Committee*, Dr. Harry Blair and Dr. Nolan Kaltreider. At the same meeting the late Professor-Emeritus Herman L. Fairchild, Professor-Emeritus Victor J. Chambers and Professor John R. Murlin were elected honorary members "in recognition of their meritorious service to the local chapter." The induction ceremonies were held on May 2.

THE annual meeting of the Tufts College Chapter was held on May 11. Following the initiation of newly elected members and associate members, the officers for the academic year 1944–1945 were installed: *President*, Dr. Paul A. Warren, biology; *President-elect*, Dr. David Rapport, medicine; *Vice-president*, Dr. Alvin H. Howell, electrical engineering; *Secretary*, Dr. Nils Y. Wessell, psychology; *Treasurer*, Dr. Herman R. Sweet, biology. The address of the evening was presented by Professor Kenneth Roeder, assistant professor of biology. He spoke on "The Physiology of Nerve Conduction."

A CHAPTER of the Society of the Sigma Xi was installed recently at Wayne University. The ceremonies were conducted by Dr. Harlow Shapley, president of the society, and Dr. George A. Baitsell, executive secretary. Dr. Shapley gave the installation address entitled "On Cooperation in Research." He also spoke later in the program on "Star Clusters." The officers of the chapter are as follows: *President*, William H. Pyle; *President-elect*, Arthur H. Smith; *Secretary*, Helen I. Miner; *Treasurer*, Ralph G. Janes, and *Member of Executive Committee*, Charles W. Creaser.

THE AMERICAN ACADEMY OF ARTS AND SCIENCES

AT the annual meeting of the American Academy of Arts and Sciences, held on May 10 at its house at 28 Newbury Street, Boston, the election of [illegible]

new fellows and four foreign honorary members was announced. The list of those elected in the sciences follows.

MATHEMATICAL AND PHYSICAL SCIENCES

Isadore Amdur, assistant professor of physical chemistry, Massachusetts Institute of Technology

Arthur Robert von Hippel, associate professor of electrical engineering, Massachusetts Institute of Technology.

Ronold Wyeth Percival King, associate professor of physics, Harvard University.

Saunders MacLane, associate professor of mathematics, Harvard University.

Richard Martin Edler von Mises, lecturer on aerodynamics, Harvard University.

John von Neumann, professor of mathematics, Institute for Advanced Study, Princeton, N. J.

Linus Carl Pauling, professor of chemistry, California Institute of Technology, Pasadena

Karl Terzaghi, lecturer on soil mechanics, Harvard University

Edgar Bright Wilson, Jr, associate professor of chemistry, Harvard University.

NATURAL AND PHYSIOLOGICAL SCIENCES

Maxwell Finland, assistant professor of medicine, Harvard University.

Paul Rupert Gast, assistant professor of forestry, Harvard University.

Columbus O'Donnell Iselin, 2d, director of the Oceanographic Institution, Woods Hole.

Eugene Markley Landis, professor of physiology, Harvard University.

William Malamud, clinical director of the Worcester State Hospital, Massachusetts

Hugh Miller Raup, assistant professor of plant ecology, Harvard University.

Albert Charles Smith, curator of the herbarium, Arnold Arboretum.

Harald Ulrik Sverdrup, director of the Scripps Institution, La Jolla, Calif

George Widmer Thorn, physician-in-chief, Peter Bent Brigham Hospital, Boston.

Ezequiel Ordoñez, geologist, Mexico, D.F., was elected an honorary member.

The following officers were elected for the year 1944–1945.

President, Howard Mumford Jones.
Vice-presidents, George R Harrison, Alfred C. Lane, Ralph E. Flanders, Fred N. Robinson
Corresponding Secretary, Abbott Payson Usher.
Recording Secretary, Hudson Hoagland
Treasurer, Horace S. Ford
Librarian, Frederick H. Pratt
Editor, Robert P Blake

SCIENTIFIC NOTES AND NEWS

DR. ERNEST W. GOODPASTURE, professor of pathology and associate dean of the School of Medicine of Vanderbilt University, was presented on May 9 at the fifty-eighth annual meeting, held in Atlantic City, of the Association of American Physicians, with the George M. Kober Medal in recognition of his work on viruses. The award is made annually to a member of the association "for outstanding contributions to the progress and achievements of preventive medicine."

THE Willard Gibbs Medal for outstanding work in chemistry of the Chicago Section of the American Chemical Society has been awarded to Dr. George Oliver Curme, Jr., of New York, director of research for the Carbide and Carbon Chemicals Corporation, "in recognition of his work in aliphatic chemistry" The medal will be presented at the coming meeting of the section.

THE Gold Medal of the American Institute of Chemists was presented on May 13 to Dr. Willard H. Dow, president of the Dow Chemical Company, "for his contribution to the war in the large-scale production of magnesium and styrene." At this meeting Dr. Gustav Egloff, research director of the Universal Oil Products Company, Chicago, who presided over the sessions, was reelected president of the institute.

DR OLAF ANDREAS HOUGEN, professor of chemical engineering at the University of Wisconsin, was presented with the 1944 William H. Walker Award at the Cleveland meeting of the American Institute of Chemical Engineers in recognition of "outstanding contributions to chemical engineering literature." Dr. T. H. Chilton, of the du Pont Experimental Station, made the presentation.

PROFESSOR V. C. ILLING, professor of oil technology at the Imperial College of Science and Technology, London, has been awarded the Murchison Medal of the Geological Society, London.

THE Council of the Royal Society of Edinburgh has awarded the Keith Prize for 1941–43 to Professor James Ritchie, professor of natural history at the University of Edinburgh, "for his papers in the *Proceedings* of the society, in recognition of his distinguished contributions to natural history," and the Neill Prize for 1941-43 to Dr. Douglas A. Allan, director of the Liverpool Public Museums, for his papers published in the *Transactions* on "The Geology of the Highland Border Region."

PROFESSOR EVGENI PAVLOVSKY, of the Academy of Sciences of the U.S.S.R., since 1929 professor of zoology and comparative anatomy at the Military Medical Academy and lieutenant-general of the Soviet Medical Service, was awarded on the occasion of his sixtieth birthday the Order of Lenin "in recognition of his work in the field of parasitology."

THE degree of LL.D., *honoris causa,* will be conferred by the University of Aberdeen on Professor A. Findlay, president of the Royal Institute of Chemistry, and on Dr. V. M. Goldschmidt, professor of mineralogy and geology at Oslo.

DR. HUGH S. CUMMING, director of the Pan American Sanitary Bureau, was elected president of the fifth Pan American Conference of National Directors of Health, which met from April 22 to 29 in the Pan American Union in Washington. Vice-presidents elected were Dr. Manuel Baez, of Mexico; Dr. Eugenio Suarez, of Chile; Dr. Cesar Zuleta, of Peru; and Dr. Leopoldo Perez, of Ecuador. Dr. Aristides A. Moll was elected secretary-general.

THE officers of the American Institute of Nutrition for the coming year are Dr. Icie Macy Hoobler, *President;* Dr. Wm. C. Rose, *Vice-president;* Dr. Arthur H. Smith, *Secretary;* Dr. E. M. Nelson, *Treasurer,* and Drs. Geneviève Stearns, T. H. Jukes and C. A. Elvehjem, *Councilors.*

THE meeting on May 5 of the Section of Chemistry of the Ohio Academy of Science was presided over by Dr. H. J. Garber, assistant professor of chemical engineering of the University of Cincinnati. At this meeting Dr. Roy G. Bossert, of the department of chemistry of the Ohio Wesleyan University, was elected chairman for the coming year, and Dr. P. Rothemund was elected a member of the committee on membership.

AT the twenty-sixth annual business meeting of the American Society of Mammalogists, held in New York, the following officers were elected for 1944: *President,* E. Raymond Hall; *Vice-presidents,* E. A. Goldman and E. A. Preble; *Recording Secretary,* Seth B. Benson; *Corresponding Secretary,* Emmet T. Hooper; *Treasurer,* Viola S. Schantz; *Chairman of the Editorial Board,* William B. Davis; *Directors for 1943–45,* Victor H. Cahalane, William J. Hamilton, Jr., J. Eric Hill, Remington Kellogg and Otis Wade; *Directors for 1944–46,* R. M. Anderson, W. Reid Blair, William H. Burt, J. Kenneth Doutt and Claude W. Hibbard. H. E. Anthony was elected a trustee for the period from 1944 to 1947.

AT the annual meeting on May 5 of the New York Section of the American Chemical Society, Dr. Beverly L. Clarke, head of the analytical department of the Bell Telephone Laboratories, Inc., was elected chairman. He succeeds Professor Vincent du Vigneaud, head of the department of biochemistry of the Cornell University Medical College. Dr. R. A. Baker, head of the department of chemistry of the College of the City of New York, was made chairman-elect; Professor E. J. Durham, of New York University, was appointed secretary, and Dr. William W. Winship, manager of the American Division of Thermal Syndicate, Ltd., was elected treasurer. At this meeting Dr. Leonor Michaelis, of the Rockefeller Institute for Medical Research, gave an address on "Organic Molecular Compounds of the Quinhydrone Type."

THE title of emeritus has been conferred on Dr. Louis J. Curtman, of the College of the City of New York, with which he has been associated since 1907, becoming professor of chemistry in 1934.

DR. WALTER H. BROWN, chairman of the department of hygiene of the University of California at Berkeley, has been made acting dean of the newly established School of Public Health, for which an appropriation has been made by the State Assembly of California. Other schools and departments of the university, including medicine, medical research, education, nursing, home economics and sanitary engineering, will participate in its work. The name of the department of hygiene has been changed to the department of public health.

SIR JOHN FRASER, regius professor of clinical medicine of the University of Edinburgh, has been appointed principal of the university.

DR. HOMER L. SHANTZ, since 1936 chief of the Division of Wildlife Management of the U. S. Forest Service, previously for eight years president of the University of Arizona, retired early in April.

JAMES H. QUINN, chief preparator in the division of paleontology of the Chicago Natural History Museum, has left the museum to enlist in the Navy.

DR. CHRISTIAN A. RUCKMICK, who recently served as chief civilian psychologist in charge of mental testing at the U. S. Armed Forces Induction Station at Peoria, Ill., has been appointed supervisor of training on the staff of the Chicago and North Western Railway Company. He is in charge of a project which will ultimately involve the training of the thirty-two thousand employees of the railroad in cooperation with the Section of the Training within Industry of the War Manpower Commission. He is also serving as chairman of the committee on psychological techniques in the Organization of Techniques of the Office of Civilian Defense for the Metropolitan District of Chicago.

DR. FRED M. BULLARD, professor of geology and mineralogy at the University of Texas, will continue his studies on Parícutin this summer under a grant from the Geological Society of America. He will teach a course on the "Volcanoes of Mexico" in the Summer School of the National University of Mexico, in collaboration with Dr. Ezequiel Ordoñez, as a member of the faculty of the field school sponsored by the Institute of Latin American Studies of the University of Texas. Following the session he plans to spend approximately three months in a field study of Parícutin and related areas.

DR. ALBERT L. HENNE, professor of chemistry at the Ohio State University, an authority on fluorine compounds, is spending several weeks as research associate at the University of California at Los Angeles. While there he will deliver the William Conger Morgan Memorial Lecture, speaking on "Aliphatic Fluorides."

THE Messenger Lectures of Cornell University for 1943–44 were given during April by Dr. Griffith Taylor, professor of geography at the University of Toronto. The series of six lectures was entitled "Our Evolving Civilization."

DR. HOWARD T. KARSNER, professor of pathology at Western Reserve University, delivered on May 18 the first Frederick Robert Zeit Lecture sponsored by the Xi chapter of the Alpha Kappa Kappa Fraternity at the Medical School of Northwestern University. He spoke on "Hepatic Cirrhosis."

DR. R. R. SPENCER, chief of the National Cancer Institute, Bethesda, Md., delivered on May 3 the George Chase Christian Cancer Lecture at the Medical School of the University of Minnesota. The lecture was entitled "Biological Adjustment and Its Relation to the Carcinogenic Process." He also spoke on "Newer Techniques in Cancer Research" and on "The Public Stake in Cancer Research."

THE American Physical Society will meet at Rochester, N. Y., on June 23 and 24. The two hundred and sixty-second meeting will be held on July 22 at the University of California at Berkeley.

THE twentieth annual meeting of the West Virginia Academy of Science was held at Fairmont State Teachers College on May 5 and 6. While the program was somewhat smaller than usual there was an unusually large attendance considering the travel restrictions. The Division of Higher Education of the State Education Association was invited to hold its meeting with the academy and to participate in the program. Dr. Horace B. English, of the Ohio State University, gave the address at the annual banquet. He spoke on "Psychology in the Post-war World." The officers elected for the coming year are E. Meade McNeill, Athens, *President;* Hanibal A. Davis, Morgantown, *Vice-president;* Nelle Ammons, Morgantown, *Treasurer;* J. E. Judson, Buckhannon, *Secretary.* The next annual meeting will be held at Concord State Teachers College at Athens, W. Va.

RUTGERS UNIVERSITY has established a research council to promote research in all departments of the university. A survey is now being made of personnel and facilities to determine where new funds for research can best be invested. The council consists of nine members representing various fields of knowledge and colleges of the university. Dr. William H. Cole, since 1928 professor of physiology and biochemistry, has been appointed director of the council. He will serve in a staff relationship to deans, heads of departments and members of the faculty concerning research programs, and will represent the university in developing reciprocal arrangements with governmental, industrial, business and professional institutions outside the university. A special research fund has been placed at the disposal of the council and applications for grants for next year are now being considered.

DISCUSSION

THE OPERATIONAL VIEWPOINT IN HARDNESS MEASUREMENTS

THE appearance of a recent book[1] on the subject of hardness—the first, so the author says, to be written by a physicist—reopens an old question (actually it was never closed) which is of vital importance in the war effort as well as of general interest to science and industry.

The problem of hardness is distinctly a problem for the physicist, but the realm of physics must be understood to include such extensive fields as metallurgy, chemistry, x-rays, quantum theory and mathematics; and the subject of hardness is not only of interest to these but to a host of professions and industries ranging from the iron and steel industry to dentistry, and from ordnance to pottery. The importance of the concept needs no demonstration when one considers that the hardness of armor plate or shell tips might mean the difference between the survival or downfall of democracy and freedom.

In recent years the long existing confusion about hardness has been partially but not completely clari-

[1] "Hardness and Hardness Measurements," by Professor S. R. Williams, Amherst College. Published by American Society for Metals. 1942.

fied. Strangely enough, modern general physics texts say little or nothing about hardness, though in relation to touch it is one of our most common experiences in the physical world. Older physics texts usually listed hardness as one of the important properties of matter but went little further. A leading text of fifty years ago said, "Hardness is a property that can not be measured," and a popular dictionary says that "hardness is the quality or state of being hard." Neither of these statements is useful. The difficulty is that the word is not only asked to do double duty in the world of common experience and in the technical world, but it is also asked to do multiple duty in the technical world as all the various present-day hardness tests measure different sets of properties. The term "sets of properties" is used advisedly because a single type of hardness test such as the indentation of a steel surface with a diamond point may involve many properties such as compression, shear, slip, fracture, etc. To make matters bad, the relative amounts of these properties may vary as the test progresses. And to make matters still worse there is, as Williams himself has said, no known method of hardness testing (even magnetic methods) which do not change the hardness of the sample as the test progresses either by cold working, magnetic working, etc. This reminds one of quantum measurements in the remote atomic realms in which the act of measuring defeats the object of the measurement. Such defeatism may be a characteristic of all measurements pushed to an extreme, but here one faces the problem in the realm of everyday practical measurements.

New tests for hardness are continually being invented, and many comparisons of the results of different tests have been made, but the problem can not be satisfactorily solved until the test elements are reduced to utmost simplicity and clearly defined. From such a viewpoint it appears that the problem of hardness is one in which the recognition of the value of the operational viewpoint is particularly desirable. Just as in the case of velocity and other apparently simple concepts, the concept of hardness can have no real meaning aside from the operations which have been performed. The operations performed here, however, are much more complicated than those of reading a clock and a scale of length to get a velocity, even though we recognize the relativistic complications in the concept of velocity. But here, though the operator may only turn a wheel or release a lever, the testing machine is itself performing a set of complicated operations. Take, for instance, indentation by a diamond point and consider the many elements as indicated above into which the apparently simple operations can be resolved. This manifold of operations must be understood if the measurement is to have meaning in terms of them. This is exactly the standpoint taken by Professor Williams, who without actually using the term operational viewpoint has spent many years prying into the multiplicity of operations which go to make up a particular hardness test. But the field is so large and the types of training which are needed are so varied in even apparently simple investigations, as the author has shown, that there is plenty of work for the future. Some idea of the amount of work already done can be obtained from the bibliography of approximately 2,000 references in Professor Williams' book.

The confusion in the past over the question of hardness has been largely due not only to the large variety of methods of testing hardness but especially to the conflicting viewpoints of metallurgists, physicists and others who are only now being drawn together by a clearer recognition of the fundamental principles involved. For instance, one example of a radically different viewpoint from that outlined above is the work of D. Landau, who by a method of dimensional analysis has arrived at a formula for hardness $H = CE^mL^n$ where H is a numerical measure of hardness; C is a constant; E is the modulus of elasticity; L is the compression elastic limit, and m and n are small positive numbers. Such a procedure may imply the existence of an absolute standard or it may set up an arbitrary standard which the formula approximates. But it implies that we know much more about the dimensions involved than we actually do and it neglects the operations on which a knowledge of such dimensions is based and which vary from one experimental procedure to another. Neither would the operations involved be easy to apply to a series of samples.

If workers in the field will recognize the fundamental character of the operational viewpoint a considerable forward step would be taken toward a common meeting ground for those workers of diverse interests, and widely different types of training whose views in the past have often seemed irreconcilable. But to further such a position it will be necessary to do much more experimental work in clarifying and defining the operations involved, excellent though the beginning already made may be.

ROGERS D. RUSK
MOUNT HOLYOKE COLLEGE

THE POSSIBILITY OF PREVENTION OF TUBERCULOSIS BY NON-POISONOUS CHEMICAL AIR DISINFECTION AND BY KILLED VACCINES

OF all diseases tuberculosis is one of the most common and also costly to handle, since it is relatively refractory to all known methods of treatment, except prolonged rest in bed. The great desirability of preventing this infection is therefore obvious, but meth-

ods of accomplishing this purpose are too few and for some time but few advances in method have been obtained along the lines recently pursued. One conspicuous advance was the determination of the lethal action of ultra-violet light on tubercle bacilli, *in vitro*[1] and in air.[2] Good diagnosis also has been obtained and this has made possible a policy of detection and slaughter of infected livestock, and a parallel policy of detection and segregation of infected humans. The perfect fulfilment of these policies would doubtless be quite effective, but is severely hampered in various parts of the world by the tremendous cost of execution. This country alone has roughly two million[3] tuberculous humans, and in comparison with other countries our own is an island of safety. In recent years, as frequently pointed out in your columns,[4] a group of scientists at this university have given us a brilliant new lead: Chemical air disinfection in closed spaces. With respect to tuberculosis this lead has remained undeveloped.

I have recently determined, by guinea pig test, the fact that tubercle bacilli (Ravenel bovine-type), in fine suspensions at 70° F are rapidly killed by immersion and agitation in propylene or triethylene glycol of 60, 70, 80 or 90 per cent. strengths. Of 82 guinea pigs subcutaneously inoculated with tubercle bacilli subjected to such treatments for 3-, 5-, 10- or 15-minute periods, not one animal showed as large and numerous lesions as control animals, at the site of injection, regional and iliac lymph nodes, spleen, liver and lungs. Rapid and extensive destruction of pathogenicity invariably occurred. In 80 per cent. propylene glycol this destruction was complete within 5 minutes and in triethylene glycol within 15 minutes. Even in lesser concentrations death was often complete within 15 minutes. Minor irregularities in the outcome may have been due to variations in the size of bacillary aggregates in various tests.

Since the glycols, as vapors, are infallibly attracted to moist dust in the air, and kill almost all non-spore-bearing bacteria[5] if suspended in properly humid air, it is difficult to escape the conviction that a useful degree of chemical air disinfection of tubercle bacilli might be worked out by a sustained attack. Killing *in vitro*, however, is slower than that reported for some other pathogens.[6] Also, the practical success of the scheme will, at best, depend upon actual maintenance of effective glycol vapor concentrations in the vicinity of infectious bacilli. The rapid mastery of numerous difficult problems, both experimental and engineering in nature, merits, in my opinion, the allocation of large funds. The inspiration for this attack must be obvious to all bacteriologists, but the originators of the method are fully engaged on other problems, and for this reason any inquiries should be directed to myself.

Incidentally the possibility of an anti-tuberculosis vaccine of bacilli suspended in a glycol seems worth examination. Such a vaccine, if found effective, would have the advantages accruing from permanent freedom from contamination, low temperature killing, high dispersion and consequent relative ease of absorption in tissues, etc. This subject derives enhanced importance (a) from the frequent inacceptability or unavailability of living vaccines, such as BCG; (b) the enormous, rapidly approaching need in the post-war world; (c) the rather tardy appreciation of moderate degrees of immunity, by the rabbit protection test;[7] and (d) the consideration that protection against only the first of a series of minute subfatal infecting doses might often decide the whole outcome: Most investigators now accept the proposition that complete conquest of a primary infection imparts a moderately enhanced resistance, at least as great as that conferred by BCG.[3]

The similarity in structure between the glycols and glycerol,[8] a normal metabolite of many organisms, enlarges the horizon for "fooling" our pathogens.

TRUMAN SQUIRE POTTER

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[1] E. Mayer and M. Dworski, *Am. Rev. Tuber.*, 26: 105, 1932.

[2] W. Wells and M. Lurie, *Am. Jour. Hyg.*, 34: (Sect. B) 21, 1941.

[3] R. G. Bloch *et al.*, *Am. Rev. Tuber.*, 37: 174, 1938 and *Am. Jour. Roent. and Rad. Ther.*, 49: 463, 1943.

[4] O. H. Robertson *et al.*, SCIENCE, 97: 51, 1942, and 495, 1943; 98: 479, 1943. Also *Jour. Exp. Med.*, 78: 387, 1943.

[5] Just as the sulfa drugs may help to cure tuberculosis by quelling secondary invaders, the glycols may become indispensable treatment in sanatoria, for attacking these agents while still in the air.

[6] Killing in air is being subjected to provisional tests. Bacilli in sputum droplets will obviously be in a different state of aggregation than the warty, coherent colonies somewhat incompletely broken up here. A thin film of mucus on air-borne bacteria has been found by Robertson to be favorable to their killing by glycols; the mucus presumably retains moisture, and therefore traps glycol.

[7] T. S. Potter, *Proc. Soc. Exp. Biol. and Med.*, 54: 145, 1943; *Jour. Am. Med Asn.*, 124: 527, 1944. E. Opie *et al.*, *Jour. Exp. Med.*, 66: 761, 1937; *Am. Jour. Hyg.*, 29: (Sect. B) 155, 1939.

[8] C. H. Boissevain, *Proc. Soc. Exp. Biol. and Med.*, 54: 342, 1943. As to the penetrating power of glycols for bacteria, see also T. G. Randolph and R. F. Mikell, *Am. Rev. Tuber.*, 49: 109, 1944.

SALMONELLA ISOLATED FROM HUMAN MESENTERIC LYMPH NODES

STUDIES have been made investigating Salmonella from pig's mesenteric lymph nodes, the papers of Hormaeche and Salsamendi,[1,2] Rubin,[3] Edwards, Brunner and Rubin[4] and Varela and Zozaya,[5] all

[1] *Arch. Urug. Med. Cir. Esp.*, 9: 665, 1936.

[2] *Ibid.*, 19: 375, 1939.

[3] *Jour. Bact.*, 40: 463, 1940.

[4] *Proc. Soc. Exp. Biol. and Med.*, 44: 395, 1940.

[5] *Rev. Inst. Salub. Enf. Trop.*, 2: 311, 1941.

these investigators identified various species of Salmonella. The present publication reports the results of an investigation of Salmonella cultured from the mesenteric lymph nodes of 171 persons dying of different maladies in the General Hospital of Mexico. D.F.

The technique employed in this study was the same as that utilized previously in our study of Salmonella obtained from pigs.[5]

We isolated four species of Salmonella of Group B, five species of Group C and one species of the Further Groups. Twenty-seven Salmonella were identified: *S. typhimurium* 5 times, *S. oranienburg* 6, *S. newport* 4, *S. muenchen* 4, *S. montevideo* 3, *S. reading* 1, *S. essen* 1, *S. chester* 1, *S. choleraesuis* 1 *and S. carrau* 1.

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SCIENTIFIC BOOKS

SINANTHROPUS PEKINENSIS

The Skull of Sinanthropus Pekinensis. A comparative Study on a Primitive Hominid Skull. FRANZ WEIDENREICH. *Paleontologia Sinica,* New Series D. No. 10, Whole Series No. 110. Published by the Geological Survey of China, 1943. New York. N. Y.: G. E. Stechert and Company. 278 pages of text. 38 tables. 93 plates. Index and Bibliography.

THIS massive and cumulative study of the human remains found near Peking is without doubt the most significant and important treatment of the whole subject of fossil man to appear in many decades. Perhaps indeed, because of its wealth of new information, it is the most significant comparative study yet to be made in the entire field of human paleontology. That the work has been brought forth in the midst of war, at a time when even the whereabouts of many of these precious fossils is unknown, is a tribute to American democracy and to the single-hearted devotion to science of Franz Weidenreich.

A pupil of the late Gustaf Schwalbe, whose broad interests ranged over many fields of biology, Dr. Weidenreich has been the carrier of a great tradition in a day when narrow specialization has too often impeded the course of science. That there are men in our universities who know his name as a histologist and not as a paleontologist, that anthropologists are often unaware of his contributions in other fields than their own, is both indicative of the breadth of his interests and the increasingly divergent paths of the anatomical sciences. It has been exactly forty years since Dr. Weidenreich wrote his first paper upon the development of the human chin, begun, characteristically, when he was actively engaged upon the study of the blood and its related organs. The present work is the product of decades of wide labor in seemingly remote fields, all of which have contributed to the scholarship brought finally into splendid focus in the writing of this volume.

The book begins with an account of the discoveries at Choukoutien, their state of preservation and an explanation of the methods employed in their restoration. Part II is devoted to an analysis both of the structural features of the crania in general, and the characters of the individual bones. The metrical as well as the morphological features receive detailed attention. Variations, both sexual and individual, are noted and the character of the *Sinanthropus* skull thoroughly established. Needless to say, its right to a position in the human phylogeny distinct from that of the Neanderthal type is thoroughly demonstrated. Part III of the monograph is devoted to a comparison of the Peking material with other fossil types such as *Homo soloensis, Pithecanthropus, Africanthropus,* the Australopithecines and other more recently discovered remains. Not content with his exhaustive treatment of *Sinanthropus,* Dr. Weidenreich details many new and pertinent observations upon these latter forms, as well. In conclusion, he ventures extended general comment upon the course of human evolution in the light of the evidence available to our generation.

The salient characters of *Sinanthropus* may be indicated in compressed form as follows: A completely erect posture, associated with a skull and face still in the grip of active evolution from an anthropoid to a human state. The skull is dolichocephalic averaging at 72.2. The great thickness of the cranial vault is a marked element in the low cranial capacity, which ranges from 915 cc to 1,225 cc with an average, for five skulls, of 1,043 cc. The supra-orbital ridges are massive and protrude beyond the infra-orbital border. The marked post-orbital constriction and small size of the brain case combine to produce a markedly phaenozygous skull. The nasal bridge is broad and short, the anterior nares wide and low. There is no nasal spine. The torus occipitalis "appears as a continuous broad bulge . . . which crosses the occipital bone in its entire breadth. . . ." The breadth of the skull is greatest at the biauricular plane, and, unlike the condition in modern man, decreases above that level. The skull is low and there is a pronounced sagittal crest

or ridge. After a careful consideration of the problem of suture-closure, Dr. Weidenreich records the suspicion that growth and aging took a more accelerated course in *Sinanthropus* than in *Homo sapiens*. Sexual distinctions in size may have been a little more pronounced than in modern populations.

The species is viewed as lying on the direct line of ascent to modern man, with certain characters suggesting Mongoloid affinities. Dr. Weidenreich does not share the rather widely held view that the modern races are relatively recent variants from a generalized *sapiens* stock. Instead, he regards present human varieties as the product of already existing racial variations among the earlier hominids.

Taking exception to the views of Gregory and Hellman that *Dryopithecus* represents the stock from which both the human and anthropoid branches were derived, Weidenreich expresses the belief that the dentition of *Dryopithecus* and related forms betray specializations already suggestive of the anthropoid rather than the human line. Just as seriously, he has considered and rejected his own earlier views upon *Homo soloensis*. On the basis of more extended information, he now regards this form not as an Asiatic Neanderthal, but as an even more primitive variety lying in an intermediate position between the Pithecanthropus and Neanderthal stages.

Dismissing *Eoanthropus* as an "artificial combination of fragments," Dr. Weidenreich feels that our accumulated remains are now sufficient to establish a reasonably clear line of ascent to modern man. Furthermore, he regards this line as unbroken by extreme saltatory variations. The existence of more advanced forms, anatomically, in early geological periods which also reveal the presence of more primitive hominids, is explained on the basis of retardation in some areas, more rapid advance in others. Thus the living Australian he would regard, not as an archaic Pleistocene survival, but young in the sense that he has more recently attained a status through which the more phylogenetically advanced types have already passed. It remains to be seen whether the recently reported Keilor skulls suggesting, according to reports,[1] great antiquity for the Australoid stock, will force a reconsideration of this view.

Obviously some of Dr. Weidenreich's opinions will be challenged. The theory expressed above, for example, is capable of political distortion and has social implications which will not be well received in some quarters. To say this, however, does not prove Dr. Weidenreich's theory to be wrong, and certainly he offers it objectively, with no thought of stimulating racial disparagement. In seeking for an explanation of undoubted discrepancies between anatomical status and the geological age of more or less simultaneously existing Pleistocene forms, Dr. Weidenreich has fallen back inevitably upon an explanation, which, if true, might by indirection be taken to imply racial "childhood" for certain existing peoples. The mental implications of this view are not discussed, but they are too iconoclastic from the standpoint of the sociologist to be ignored.

The possibility of inequalities in the speed of development of various human types will be certain to add fuel to the controversy over racial superiority. Without attempting to assay the argument here, let it be pointed out that Dr. Weidenreich himself slyly comments that the European *sapiens*, on the basis of geological evidence, "must either be older or its later development must have been somehow more retarded than is the case with the Southeast Asiatic line. . . ." This good-humored remark should, I think, prove ample protection from charges of partiality toward the European branch of mankind.

Irrespective of some of the author's more tentative ventures into the unknown, the amount of anatomical detail available in the compass of this single volume makes it a priceless acquisition for the paleontologist and comparative anatomist. The book is more than a study of *Sinanthropus*. It is a vast and painstaking review of the whole subject of human evolution enlivened by an extremely thorough and original mind.

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REPORTS

WARTIME INVESTIGATIONS AT THE MELLON INSTITUTE. II

SCIENCE SERVES SYNTHETIC RUBBER

The production, purification and analysis of butadiene and styrene have been investigated searchingly by the multiple industrial fellowship on tar synthetics, and the fruitful results have been put in industrial practice at Kobuta, Pa. No success here has had a stronger spur and the rapid and very beneficial outcome demonstrates how war stimulates excellence in research. Studies have eventuated in specifications for metals most suitable for butadiene and styrene plant construction. Worthy fundamental work has been done on the physical chemistry of the purification of synthetic rubber raw materials. The polymerization phenomena of butadiene, styrene and acrylonitrile are under close scrutiny. In an adjacent field new tests

[1] F. H. H. Roberts, *Scientific Monthly*, 58: 156–157, 1944.

for adhesive properties and aging characteristics of tapes and for the rheological properties of elastomeric adhesives have been adopted as guides in the development of novel adhesive compositions. Extremely finely divided silicate minerals have been found satisfactory as reinforcing fillers for natural and synthetic rubbers.

Discoveries in Protective Coatings

The fellows in the domain of protective coatings have similarly shown ready and productive responsiveness to heavy demands. Investigations were continued on underwater coatings and several papers were published on the basic aspects of antifouling paint performance. Exhaustive studies of possible accelerated corrosion effects arising from the accidental or deliberate contacting of steel hulls by the antifouling paint have disclosed that appreciable acceleration can arise under the usual type of heavy metal-containing antifouling compositions. The interposition of even a single barrier paint coat substantially eliminates any accelerated attack, though all tests indicate the desirability of employing at least two such intermediate coats. Accidental contact with large areas of the hull not only causes accelerated pitting but also may inactivate the antifouling paint.

Some New Compounds and Their Uses

Descriptions were released of simple and differential cryometers for measuring the degree of purity and the freezing temperatures of liquid or melted substances. An article set forth information on foam formation in organic liquids. The production of alkylene polyamines is being delineated precisely for industrial application. New organo-silicon compounds have been prepared and made commercially. The likely industrial utility of new aluminum derivatives has been surveyed from all points of view. From investigations on nickel compounds and catalysts, products have been developed that are of promise in the synthesis of motor fuel, in the preparation of chemicals for synthetic rubber and as ingredients for lubricants, paints and combination insecticides-fungicides. In other insecticide research several difficult assignments have been dealt with. For instance, an insecticide has been originated which is being tested for use in an important war application. Then, too, the betterment of insect repellents is being carried forward.

Success in the Pharmaceutical and Chemical Hygiene Fields

Several new organic iodine compounds have been prepared in research relating to improved iodine antiseptics. A novel commercial synthesis of theophylline has been achieved. Work on intermediates for sulfa drugs has kept pace with current advances in the field. A new petrolatum gauze has been developed. Dehydration of gypsum to produce plaster for surgical casts has been accomplished by an improved process. The original paths of research of the Industrial Hygiene Foundation at the institute have become avenues of progress. In chemical hygiene by means of animal and human experiments there have been completed studies on the toxicity of several new products and of materials whose health hazards were unknown, all of them used by the military forces or by prime government contractors: dioctyl phthalate, new cable-impregnating compounds, low-temperature lubricants, extreme-pressure lubricants, newer insect repellents, a new textile lubricant and cobalt oxide dust. "Range-finding" toxicity tests have been performed on twenty-two new organic chemicals which are under industrial development owing to war demands. Altogether twenty-six of the hundred fellowships in operation relate to specific divisions of chemical technology.

The Institute's Department of Research in Pure Chemistry

The interests of this department have been directed chiefly toward studies on synthetic antimalarial drugs. The presence of U. S. Armed Forces in tropical areas (in which the hazards of climate and of endemic infections are foreign to conditions normal in most of our country) has given immediate pressure to the need for new chemotherapeutic agents for combating diseases which, in the past, were but occasionally found in our coastal cities and metropolitan centers, except in the southern states. Along with many other American laboratories, special emphasis has been placed on the synthesis of compounds which might prove of value in the treatment of malaria and of certain other infections previously rare within our own borders.

The Urgency of Research on Antimalarials

Even prior to our entry into the war, the need for new and more efficient therapeutic agents for coping with malaria was beginning to attract some share of the recognition to which this most important medical problem is entitled. The ability of this disease to influence the course of military campaigns, demonstrated again on many battlefronts of World War II, has brought into sharp focus our deficiencies regarding drugs capable of controlling the infection. It has been reported that 85 per cent. of the U. S. and Filipino troops on Bataan suffered from malaria, and that the

infection rate in the South Pacific has averaged nearly 50 per cent. It seems established that, until new compounds are discovered which can act as casual prophylactics or can effect a true sterilization of the disease, the war in the Pacific will continue to be fought against two enemies, the Japanese and malaria-carrying mosquitoes. The fact that research on antimalarials is more than merely a war problem is indicated by the number of publications which have appeared on the possibility of the importation of malaria into the United States at the termination of hostilities. Species of mosquitoes capable of transmitting malaria are to be found throughout the nation and the return to civilian life of men bearing chronic malaria infections may possibly be followed by the establishment of new endemic foci in sections now free from the disease. Furthermore, as the strains of the parasite introduced will in general be foreign to this country, little or no existing immunity will be found thereto. Obviously, in the face of such possibilities, the search for new and improved antimalarials will require continuation in the postwar period.

Advances in the Institute's Antimalarial Program

Owing to the extreme urgency of the problem of finding improved antimalarials to replace quinine, a drug which is now practically unobtainable since the acquisition by the Japanese of the Dutch East Indies, the activities of this department have been largely concentrated on the synthesis of new drugs of possible antimalarial value. Because of wartime limitations, it is not permissible to describe these investigations. It can be stated, however, that the results obtained with certain new drugs as antimalarial agents are sufficiently encouraging to warrant further researches. A survey article on the advances in antimalarials has been published. Under a scheme promoted by the National Research Council, arrangements have been made for evaluating the antimalarial effectivity of new drugs. Furthermore, the cooperation of those fellowships engaged in research in organic chemistry at the institute has been enlisted, so that likely compounds prepared by them may also be tested if desired. Over eighty new drugs have been submitted for antimalarial appraisal, embracing substances related to quinine, quinacrine and pamaquine; in addition, many quinoline, pyridine and aromatic derivatives have been prepared and studied. In part, efforts have been directed toward possible ways of diminishing the toxicity of chemical structures recognized as possessing antimalarial potentialities. Facilities have also been provided for testing new drugs for possible activity against trypanosome infections.

Every resource is being employed to expand the institute's area of opportunity and aid to our country at war. In this résumé it is shown that results of value have been effected by tapping the constructive power of the research staff, whose members are constantly being given channels for personal assistance through the cooperative procedures of the institution and the close contacts maintained with governmental agencies.

W. A. Hamor

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SPECIAL ARTICLES

STUDIES ON THE GROWTH OF RATS RAISED ON CHOCOLATE MILK[1]

At the present time rather large quantities of chocolate products are included in the average American dietary. A considerable amount of the chocolate is consumed in chocolate milk or in products containing appreciable amounts of milk solids. In spite of the increasing utilization of chocolate in the diet, questions are still raised concerning its possible harmful effects. Mueller and Ritchie[2] found that rats fed mineralized whole milk containing 1 per cent. of cocoa grew as well as those receiving the mineralized milk alone. When fluid chocolate milk containing more than 1 per cent. of cocoa was fed *ad libitum* the rate of consumption decreased as the percentage of cocoa added increased. When cocoa was added to whole milk powder definite retardation of growth did not result until 4 per cent. of cocoa was used. The results reported in this paper as well as those given in later papers by Mueller and coworkers[3] have attracted considerable attention because deleterious effects were obtained with the higher levels of cocoa. It is, however, difficult to evaluate the results until consideration is given to the actual amount of cocoa used in commercial chocolate milks.

Since a uniform chocolate milk was being prepared daily by our Department of Dairy Industry[1] we were asked to study its nutritional value on animals. The

[1] Published with the approval of the Director of the Wisconsin Agricultural Experiment Station. We are indebted to Mr. Gideon Hadary for the continuous supply of these milks.

[2] W. S. Mueller and W. S. Ritchie, *Jour. Dairy Sci.*, 20: [illegible]

[3] W. S. Mueller, *Jour. Dairy Sci.*, 25: 221, 1942; L. D. Lipman and W. S. Mueller, *ibid.*, 24: 399, 1941; Faye Kinder, W. S. Mueller and Helen S. Mitchell, *ibid.*, 25: 401, 1942; W. S. Mueller and Marilyn R. Cooney, *ibid.*, 26: 951, 1943.

milk was made by using 86.3 parts of whole milk and 11.7 parts of a chocolate syrup having the following composition:

Glucose	18.0 per cent.
Sucrose	33.5 " "
Invert Syrup	11.0 " "
Water	28.2 " "
Cocoa	9.0 " "
Stabilizer	0.2 " "
Salt	0.1 " "

The final product, therefore, contained 1.05 per cent. of cocoa. Another chocolate milk was prepared in the same manner except that partially skimmed milk (1.5 per cent. fat) was used. Four groups of 21-day-old rats of the Sprague-Dawley strain, averaging 40 to 45 gm, were placed on experiment. One group received mineralized whole milk, a second mineralized whole chocolate milk, a third mineralized partially skimmed milk and a fourth mineralized partially skimmed chocolate milk. The average growth at the end of four weeks for each of these groups is given in Table 1.

TABLE 1

	No of rats	Average weight in grams after four weeks on milk diets	
		Male	Female
Trial I			
Whole milk	12	172	141
Whole milk plus chocolate syrup	12	182	143
Partially skimmed milk	12	172	137
Partially skimmed milk plus chocolate syrup	12	173	148
Trial II			
Whole milk	6	164	126
Whole milk plus chocolate syrup	6	151	133

The data show that there is no inhibition of the growth of young rats when commercial chocolate milk containing 1 per cent. of cocoa is fed. It is interesting that in Trial I the growth obtained on chocolate milk diets was slightly better than on whole milk. However, in a second trial the males on whole milk grew a little better than those on the chocolate milk. None of the differences are significant. The animals on partially skimmed milk responded as well as those on whole milk. This was undoubtedly due to the fact that sufficient vitamin A was supplied even by the partially skimmed milk when it was consumed at such a high level. The fat supplied in the chocolate probably also aided in the utilization of galactose.

These rats as well as other groups were maintained on the above milks for 16 weeks without any significant difference in growth. When the rats were carried through reproduction normal young were produced in all cases but the mothers on chocolate milk had some difficulty in rearing their young. Further work is now under way to determine the exact cause of this difficulty.

Although man would never subsist on a diet containing only chocolate milk, these results appear to be of some significance since earlier work in our laboratory has shown that the growth response of rats on a mineralized milk is a critical measure of certain changes in the nutritive value of the milk.[4] While these results give no indication of reactions which may be encountered by individual human subjects, they do show that animals may be raised on a diet consisting solely of mineralized chocolate milk without any ill effect. It should also be pointed out that one per cent. of cocoa in liquid milk is equal to about 7 or 8 per cent. of cocoa on the dry basis.

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ANTIBODY RESPONSE IN MAN TO INJECTION OF THE SPECIFIC ANTIGEN OF TYPE V SHIGELLA PARADYSENTERIAE[1]

SEROLOGICALLY specific types of dysentery bacilli are frequently encountered in endemic and epidemic areas. The selection of suitable strains for use in vaccines is but one of the difficulties which arises in attempting to immunize human beings against bacillary dysentery. Furthermore, the inherent toxicity of the organisms themselves is reflected by serious local and general reactions which render the use of vaccines undesirable and often hazardous. It would seem desirable, therefore, to have at hand as a prophylactic agent a material of broad immunological specificity and devoid of many of the toxic elements of the cells themselves. With this in mind we have undertaken the isolation of the specific antigens of certain of the *Shigella paradysenteriae* and have injected human volunteers with one of these chemically purified materials.

Antigens from Gram-negative bacteria can be obtained by a variety of procedures. Thus Boivin and his collaborators[2] used trichloracetic acid for extracting the antigens from a number of different Gram-negative organisms. Topley *et al.*,[3] on the other hand,

[4] C. A. Elvehjem, E. B. Hart, H. C. Jackson and K. G. Weckel, *ibid.*, 17: 763, 1934.

[1] The work described in this paper was done under contract, recommended by the Committee on Medical Research, between the Office of Scientific Research and Development and the Rockefeller Institute for Medical Research.

[2] (a) A. Boivin and L. Mesrobeanu, *Rev. Immunol.*, 1: 553, 1935; 2: 113, 1936; 3: 319, 1937. (b) L. Mesrobeanu, "Les antigènes glucido-lipidiques des bactéries (Etude chimique et biologique)," Paris, Libraires de L'Académie de Médecine, 1936.

[3] W. W. C. Topley, H. Raistrick, J. Wilson, M. Stacey, S. W. Challinor and R. O. J. Clark, *Lancet*, 1: 252, 1937.

obtained both the H and O antigens from the typhoid bacillus by chemical fractionation of enzymatic digests of the organisms. Morgan and Partridge,[4] in their studies on the Shiga bacillus, obtained the specific antigen by extraction with diethylene glycol, and recently Morgan and Schütze[5] reported that this material has been used for the prophylactic inoculation of 12 human volunteers.

Shigella paradysenteriae Type V has been chosen for study because this organism gives rise in experimental animals to antisera which cross react broadly with other types of the Flexner group. The antigen is obtained from the cells[6] either by direct extraction with diethylene glycol or by the enzymatic degradation with trypsin of acetone-killed cells. In either case, subsequent separation from serologically inert bacterial products is accomplished by means of dialysis, precipitation of nucleic acid as a heavy metal salt followed by electrodialysis, and finally fractionation of the antigen from solution with acetone or alcohol. The material obtained by these procedures is a lipo-carbohydrate-protein complex which appears to be quite homogeneous when examined by electrophoresis. The antigen contains 4.5 per cent. nitrogen, 1.5 per cent. phosphorus and 15 per cent. phospholipid. On acid hydrolysis some 50 per cent. of reducing sugars are liberated, the antigen is broken down, and its immunological properties are destroyed. The protein-like moiety of the antigen is characterized by marked acetic properties and an unusually high tyrosine content.

The material isolated from Type V bacilli is a potent antigen which is highly toxic. Three injections of 50 micrograms given intravenously to rabbits evoke antibodies which agglutinate the homologous organisms in dilutions as high as 1:6400, and in lower dilutions agglutinate Types W, Y, Z and VZ microorganisms as well. Quantities as small as 0.5 mg invariably kill mice when injected intraperitoneally. Repeated attempts to detoxify the material without destroying its antigenic efficacy by a variety of chemical and enzymatic means have thus far been unsuccessful.

Despite the toxicity of the material, its unusual antigenic properties have enabled us to use sufficiently small doses for the production of antibodies in human beings without encountering untoward reactions. A group of 20 volunteers were injected intradermally with a total of 22.5 micrograms. The first dose of 2.5 micrograms was followed within a week by a second dose of 7.5 micrograms. The third and final dose of 12.5 micrograms was given one week later. There was little or no systemic reaction resulting from administration of these small amounts. The initial dose was in all instances followed by a local reaction which began 2-3 hours after the inoculation. The reaction consisted of swelling, redness and tenderness associated with transient lymphangitis and lymphadenopathy. The local reactions disappeared after 24–36 hours. Administration of the second dose of 7.5 and of the final one of 12.5 micrograms was unaccompanied by local or systemic reactions.

The volunteers were bled 2½ weeks following the last injection. The agglutination titer of these sera and of those collected before injection was determined. In all instances there was a marked increase in titer following inoculation, some sera agglutinating in dilutions as high as 1:800 to 1:600. These titers compare favorably with those obtained following the use of typhoid vaccine. Several antisera when tested against heterologous strains agglutinated microorganisms of Types W, Y, Z and VZ as well as those of the homologous type. The titers varied with the type and in all instances were higher than those of the pretreatment sera. That the antibodies evoked by the Type V antigen are not of a transitory nature is evidenced by the fact that the sera of several volunteers taken 6 months after injection showed no pronounced diminution in titer. When compared with the pooled pre-treatment serum, the post-treatment pooled serum showed a tenfold increase in mouse protective antibodies. A challenging dose of 1500–2000 M.L.D. of homologous Type V organisms required 0.20 cc of the former and only 0.02 cc of the latter serum to protect 50 per cent. of the animals. Furthermore, the post-treatment pooled serum showed a moderate increase in protective antibodies against virulent heterologous Type Z organisms.

A desirable agent for the prophylactic immunization of human beings against dysentery bacilli infections is one that is polyvalent and relatively non-toxic. The antigen prepared from Type V *Shigella paradysenteriae* gives rise in human beings to antibodies which are broadly cross reactive. The toxic properties of the antigen are, to be sure, undesirable, yet because of the small quantities necessary it can be used for human administration. Whether the injection of human beings with these specific antigens will afford protection against bacillary dysentery must, of course, await trials in the field.

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[4] (a) W. T. J. Morgan, *Biochem. Jour.*, 30: 909, 1936; 31: 2003, 1937. (b) W. T. J. Morgan and S. M. Partridge, *Biochem. Jour.*, 34: 169, 1940; 35: 1140, 1941.

[5] W. T. J. Morgan and H. Schütze, *Lancet*, 2: 284, 1943.

[6] We are indebted to Dr. W. A. Jamieson, of the Eli Lilly Company, Indianapolis, Indiana, for his generous co-operation in furnishing us with dysentery bacilli.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

PARAFFIN "CONWAY UNIT" FOR THE DETERMINATION OF AMMONIA

In 1933 Conway and Byrne[1] described an apparatus for the micro-determination of volatile substances such as ammonia. The unit consisted of a flat, cylindrical, glass cup with a lower concentric inner wall arising from the floor of the cup. Absorption of ammonia occurs from the outer chamber to the inner one, the entire cup having been sealed by a glass plate resting on the outer wall whose upper edge has been ground to a plane surface and smeared with vaseline. Borsook[2] modified this "Conway unit" by turning it out of lucite on a lathe and varying the dimensions to suit his electrometric determination.

Where a large number of these units are required the cost of having them made of glass, as described by Conway and Byrne, becomes excessive. Under present wartime conditions, the large lucite rods used for the manufacture of the modified form suggested by Borsook are unavailable. We attempted casting the units with acrylic resin (Trulite), the plastic used for dentures, but were unable to eliminate the inclusion of air bubbles with the molding facilities at hand. Turning to other substances we found that high melting paraffin (M. P. 55°–58° C) made highly satisfactory units. These were cast in a brass mold which was turned from a 3-inch piece of brass rod. The paraffin cups are very easily made and being inexpensive can be replaced when they become chipped, broken or discolored after long use. The material is inert to the reagents used for determining NH_3 or urea. Being white and translucent they offer an excellent background for end point titration of the indicator in the inner chamber.

The mold, Fig. 1, is cut on the lathe from a metal rod and the grooves for the walls of the unit are tapered with their bottoms somewhat rounded to facilitate the removal of the hardened cup. Loosely fitting rods fit in holes drilled through the mold as indicated in the diagram. A thin metal plate under the mold prevents these rods from falling through.

To make the cups the surfaces of the mold are first swabbed with mineral oil, then wiped clean with cleansing tissue. The liquefied paraffin is poured and as soon as the paraffin has hardened, the mold is placed in a refrigerator for about ten minutes. The hardened cup can then be easily released from the mold by tapping lightly on the rods. The upper edge of the outer wall of the unit is now ground to a plane surface by rubbing it on a flat paper-covered surface. A glass plate cover used during the period of distillation can then be securely sealed with glycerine, made alkaline to phenolphthalein.

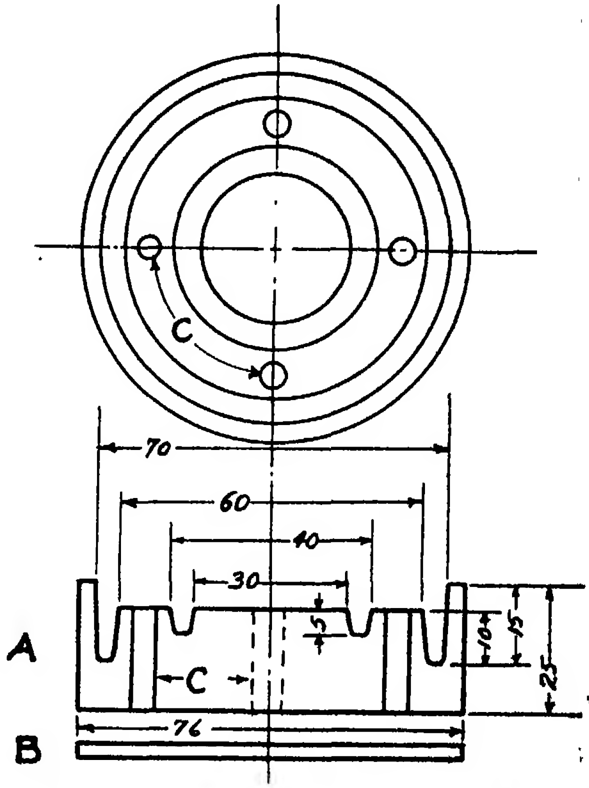

FIG. 1. A. Cross-section of mold. B. Circular metal plate for support of rods in holes C. Dimensions in millimeters.

We believe that paraffin may offer a satisfactory substitute for many other types of simple reaction vessels.

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AGE, CHANGE AND THE ADAPTED LIFE[1]

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THE interest in ageing which has expressed itself here in such a happy and helpful fashion during the past two days is not new as an intellectual adventure. The application of such understanding is in the period of its anticipated commencement. To date it has not related itself to life in the form of a basic consideration of such a process on which and from which specific interpretations of the varied manifestations of life at different age periods may be considered. The average individual, too frequently the biologist and usually the pathologist, limits his interest and confines his intelligence of ageing to narrow categories of thought. He fails to appreciate the yearning of tissues for life and the amazing chemical and structural modifications they may participate in, even gross structural changes designated disease, in order to bring about organ adaptation and the adaptation of the individual as a whole to those changes which occur as the life span progresses. The certainty of the termination of this life span and the fact that all living things are concerned with it has stimulated the imagination of poets and philosophers. Their inquisitiveness has been either romantic or dominated by resignation and has not been demonstrably helpful. Another period which concerns itself with the facts of life is in its beginning, and as these facts accumulate through chemical, biological and psychical research the romance of life will find sound ground on which to express its related beauty. Ultimate resignation will become lost in an interest in the transitory prolongation and effectiveness of the different periods of the life span. The Browning concept of the "last of life for which the first was made" will assume tangible significance.

For centuries before Cicero's great statement concerning old age thought had been given to this state of man, but only in what may be designated recent

[1] An address at the Symposium on Ageing, Washington University Medical School, Saint Louis, March 24 and 25, 1944.

years has the subject of ageing been considered in a relatedly helpful fashion. Metchnikoff[2] and Minot[3] gave serious thought to the ageing process, not only as a change in form, the morphology of senescence, but the former investigator made suggestions for the prolongation of the life of man. He was not greatly concerned with the effectiveness and pleasant relatedness of this life as years were added to it. Such a projection of the life span into and by prolonging the senile state is not helpful to the individual or to the social organization of which he is a part. In recent years several monographs[4, 5, 6] have appeared that gather together information concerning ageing and the senile individual and have served to bolster up some interest of a rather detached and philosophical nature in life processes. The masterly volume of Child[7] on "Senescence and Rejuvenescence" stands as a contribution of an experimental scientific order in an attempt by such a method to gain an insight into the phenomenon of ageing. Real and durably satisfying interest of a lasting and accurate nature in these processes has in this country come about through the concern of the Josiah Macy Jr. Foundation and the hearty appreciation of this interest by Professor E. V. Cowdry, which has culminated in the publication of two editions of his book "Problems of Ageing."[8] Here one finds not poetry or delightful prose dealing with these problems but investigations by earnest scientists into the particularities of ageing which, when considered in a composite fashion, give great understanding of these changes as a whole in both animal and plant organizations. Likely certain of these important contributions came about not primarily as previously planned studies on ageing, but as the life of plants and animals was in the process of investigation, these factors of change with age insinuated themselves for detailed consideration. They forced the investigator to take an excursion into one of the many bypaths which develop during research and which if their significance is realized may lead to plateaus affording broad vision of problems that await solution of greater worthwhileness than the meticulous problem which prompted the initial investigation. The factors of age are concealed by many chemical and later morphological manifestations of cell life, whatever they may be: they are ever present.

In Great Britain and Continental Europe one finds the counterpart of Professor Cowdry for this country in Professor V. Korenchevsky, head of the division of pathology at the Lister Institute, London, who now for reasons of greater safety and less disturbance carries on his work at Oxford University. He had once been a student of Metchnikoff and perhaps here was the source of the spark that flamed his interest in ageing. As a result of this interest Korenchevsky has formed not another society, but an intimate club-like international organization designated by him the "Club for Research on Ageing." He personally established in this country the American Division of this club which has functioned effectively for the past nine years. In addition to these interests in ageing the National Research Council, through the Division of Biology and Agriculture, has established a Committee on the Biological Processes of Ageing that affords another channel through which interest in ageing may express itself. This short and entirely inadequate statement in retrospect has been made to indicate the geographically wide concern which exists in connection with the ageing process and in turn to congratulate this medical school and those individuals who with wisdom made this conference possible.

The usual concept of age is that of a fixed, natural and irreversible process, chronologically determined by the species of animal which within certain fairly constant limitations terminates in death. Age and the processes constituting it should be seen and appreciated as living, fluid, elastic states of give-and-take for the sake of adjustment as an organism passes through its life span with those changes indicative of ageing being in some measure manifestations of an attempt of such an organism, man, to effect a working adaptation to these years. Certain of these signs of ageing represent failures in such an attempt. The important consideration for the student of ageing is to ascertain the reason for such failures and the cause for those states of premature ageing and instability which unrelate the individual to that environment in which he has to live and maintain a functional adjustment. Very recently Stieglitz in his volume on "Geriatric Medicine"[9] has brought to a focus the clinical application to date of information which we have in this domain.

The desire of tissues for life and relatedness is abundant.[10, 11, 12] They withstand repeated and con-

[2] Élie Metchnikoff, "The Prolongation of Life," G. P. Putnam's Sons, 1910.

[3] Charles S. Minot, "The Problem of Age, Growth and Death," G. P. Putnam's Sons, 1908.

[4] Aldred Scott Warthin, "Old Age the Major Invaluation," Paul B Hober, Inc., 1930.

[5] Raymond Pearl, "The Biology of Death," J. B Lippincott Company, 1922.

[6] Sir Humphry Rolleston, "Medical Aspects of Old Age," Macmillan and Company, 1932.

[7] Charles M. Child, "Senescence and Rejuvenescence," University of Chicago Press, 1915.

[8] E. V. Cowdry, "Problems of Ageing," second edition, Williams and Wilkins Company, 1942.

[9] Edward J. Stieglitz, "Geriatric Medicine," W. B. Saunders Company, 1943.

[10] Samuel Meltzer, Jr., "The Factors of Safety in Animal and Animal Economy," The Harvey Lectures, 1906–1907. J. B. Lippincott Company, 1908.

tinuous psychical and somatic insults for years before the signs of such injury develop. Even though the order of tissue change which may assert itself is of such an abnormal structure as to warrant its designation "disease," yet it may be a morphological defense mechanism to maintain life and to stabilize it at a lower level of physiological effectiveness.[13] Such changes are not infrequently seen as tissue reactions of repair to severe injury. The important and necessary understanding of ageing must come about years before such evident tissue interference develops. This information must be acquired when changes in cell life and in the individual as a whole are of a predominantly chemical order, when they are not structurally irreversible and when they afford an opportunity for chemical modification towards that normal which different animal species have established for designated age periods.

Ageing of the animal organism, of man, commences not at forty years or at some other advanced chronological period but when the male spermatozoan unites with and fertilizes the female ovum. There then commences a process of ageing with tissue differentiation and organ formation towards perfection which culminates for one period of this process at the end of the gestation period. The organism as individual at birth has so aged through constructive processes that it can now attempt to cope with a changing outside environment and by changes within itself, by processes of a physiological order, effect a functional adjustment, designated an adapted and related life. There is in such an organism no fixity of intent or purpose except to live an animal type of existence. Later with structural cerebral differentiation, the acquisition of a receptiveness on the part of such tissue, mind as learning, reason and emotion guide or fail to guide this animal body in a related fashion. The duration of the period after birth for constructive ageing towards perfection in adult life not only varies with the species of animal but with animals of the same species. In the case of man, certain families age more rapidly than others. They reach maturity more rapidly and retrogressive changes supervene at relatively earlier age periods. There is no understanding at present of the differences in the chemical constitution of the tissues of such families which determine the advent and the rapidity of the ageing process. The life span after birth furnishes a period for constructive ageing to adulthood at which time the individual shoud have reached a hypothecated normal as a balanced and related life.

[11] W. B. Cannon, "The Wisdom of the Body," W. W. Norton and Company, 1932.

[12] Wm. deB. MacNider, *Annals Int. Med.*, 17: 989, 1942.

[13] Wm. deB. MacNider, *Jour. Pharm. and Exp. Therap.*, [illegible]: [illegible], 1936.

During the periods of infancy, childhood and young life areas of a predominantly normal nature, such tissues are, in terms of their age, susceptible to accidents, designated "diseases of infancy and childhood." These transitory interruptions of this normal are usually of an infectious order and may now in many instances be specifically protected against or terminated after their development. Certain invading organisms, bacteria and viruses, appear to find tissue culture media at these age periods especially adapted, appropriately chemically constituted for their invasion and rapid multiplication. This observation at once raises the question in connection with ageing at these periods as to the chemical nature of the tissue which permits such invasions and subsequent growth of organisms. Why do we speak of poliomyelitis as infantile paralysis and thereby in terms of designation exclude on the basis of its frequency of occurrence the same specific virus disease in middle age and in senility? Such questions are rarely asked. Their solution presents an open field for research of a basic nature. An answer of a chemical order which may be found within such fixed cells that constitutes a specific affinity for the invading cells has not been approached in terms of an answer. Our attention very naturally has been focused on the organisms causing these specific diseases and on immune, protective bodies which may be produced as reactions to such tissue invasions, but we have not gone behind the appearance of these bodies to the chemical nature of cells at different age periods responsible for their production or lack of formation. The age factor, whatever that may represent in terms of chemical constitution, is the determining influence which in large measure segregates certain infectious processes.

During the age periods of infancy and childhood, over and above the accidents represented by the infectious diseases there was until some thirty or forty years ago a very high mortality in such age groups, due to imperfect feeding and disturbances of nutrition. These changes in turn certainly predisposed to the development of the specific infections. The feeding of such young tissues based on their caloric demand and the specific nutritional requirements for different chemical materials as foodstuffs was in large measure unknown. The significant influence of a general, as well as of a specific, nature of the various vitamins was unheard of. An understanding attempt could not be made to aid this young tissue in relating itself into the period of adult life. This failure was so apparent and the death rate was so high in infants and young children that a medical specialty developed, designated pediatrics. Understanding in this domain did not come about from knowledge of the adult organism. It came through the interest of in-

vestigators in detached laboratories and later at the bedside as clinical research by individuals who were willing to concern themselves with life processes, in this instance the ageing of infants and young children, the type and amount of food materials, the fluid requirements and the vitamins necessary for such young tissues as they constructively aged. In this country Jacobi, the elder Holt and now the younger Holt, Booker, Hess and of particular significance Howland, and later his great pupil and associate, W. McKim Marriott, who made with the assistance of its present head and director, the department and clinic of pediatrics at this university. To this clinic came biological chemists, physical chemists and clinicians from throughout this country and abroad to acquire an understanding of the science of pediatrics and with such knowledge to guide and relate tissues as organisms, individuals, of the early age groups as they aged towards a hoped-for perfection Such information came through research in segments of life that could readily respond to such applied science, a young age group, individuals with an inherent chemical urge[14] for normal development and relatedness. The same order of investigation is imperative, even though it is with more difficulty applied, for those individuals who have reached their summit of constructive development and at different chronological periods commence their descent towards senility Here the biochemical tendency is away from the normal. The trend is not for life, it is against it. There must develop a group of scientifically trained people from and through the laboratory and into the clinic as has been accomplished by the pediatricians, who will concern themselves with an understanding of those retrogressive changes that make not their chemical, but their gross appearance at what is designated "middle age." The chemical basis for such changes must develop years before the appearance of the structural changes. Such retrogressive tissue modifications progress with periods of transitory tissue adjustment and maladjustment until the latter state becomes permanent, fixed and only stabilized as a state of disease or as physiological senility. Such states are not reversible, even though they may as such represent periods of tissue reaction in an attempt at stabilization.

In a discussion of this order it would be unfortunate to attempt to designate by age segments from adult life into senility the nature of the physical disturbances which may supervene. There does, however, in general occur in the life span of the human being a critical period of change that has so progressed chemically between the ages of forty and fifty-five that it may with fair certainty be recognized by structural changes. Concerning the chemical shifts that develop as molecular modifications in such living tissues and that culminate in the degenerative diseases we know little in terms of certainty. Of the very greatest importance is the fact that at such periods or later is the time incidence for the development of cancer. What chemical bodies assert their action at such periods which lead to cell growth of an unguided, unrestrained order? What chemical bodies cease to exert their restraining influence on tissues at such age periods which release them for a certain wildness of life, designated malignancy? The fact of cancer is intimately associated with the factor of age. Investigation in this domain is of such a specialized nature that it requires a type of investigator of highly specialized training. An understanding, however, of the critical middle-age period in man is of a more general order and primarily concerns the biochemist and the expert in nutrition. These were the individuals who were found necessary to gain an understanding of the early age periods of constructive development.

The symptoms and signs of departures from the retrogressive, the ageing normal, are of their nature both varied and variable. They are varied, depending upon which organ, organ system or tissue expresses itself in such change and their modification, their variability in such tissues, their intensity, the readiness with which they develop, is in part genetic in origin and can be influenced by thoughtful mating. In addition to the factor of heredity, there can be little doubt of the development in certain tissues, at the middle-age period, of changes in the metabolism of cells of great significance. Such states should be amenable to the use of appropriate diets aided by accurately determined inorganic and vitamin supplements. Such was the case in infancy and childhood. We know very little concerning the food requirements for older individuals, those at their critical period of change and during their advance towards senility. Biochemical and nutritional research for such age groups is not only necessary, it is imperative if we are to prevent a considerable proportion of the degenerative diseases of middle age, stabilize individuals at such periods for toil and for happiness, and which defer the advent of those years of unrelatedness designated senility.

When accidents of a major and fatal order superimpose themselves in such individuals or when by the natural extension of pathological processes life comes to an end with all its antecedent years of incapacity, the pathologist takes over and with accuracy records these changes at the autopsy table. They remain as a record of terminal events and take their place in

[14] Joseph Needham, "Biochemistry and Morphogenesis," Cambridge University Press, 1942.

a card-indexing system. Such observations are most worthwhile, but they only serve as inelastic checks on pre-existing clinical states. Such records have little significance for, and they fail to throw the light of information on, the commencement of those bodily reactions which finally culminate in such structural changes of a gross order that the pathologist can recognize them. Sir James Mackenzie, after his stay in London as the world's most illuminating and eminent cardiologist, went back to his Aberdeen to establish an institute for the study of the commencement of disease. His thought was good. It failed to come to fulfilment. He died at a relatively early age from coronary occlusion. In considering these middle age breakdowns or the gradual progression of degenerative diseases commencing in and before this period, one fundamental type of understanding is essential. This consists in learning through research on the lower animals as well as in man the basic chemical differences in cell life as that life advances through age periods as infancy, youth and maturity to a chronological period in the life span where such chemical changes shift qualitatively, quantitatively or both, with the advent of first the symptoms and usually much later the signs, as modified structure, of commencing tissue retrogression as degeneration. Such studies are just as possible and feasible for the age periods prior to and into those of tissue degeneration which result in maladjusted individuals as they have been for the constructive age periods of tissue development and adjustment. These studies have not been made. When such segments of information are obtainable they may then be fitted together and two orders of helpfulness made available for the ageing individual—firstly, prophylactic advice and the use of natural measures for tissue protection, and secondly and with regret, attempted treatment, nutritional replacements for the existing tissue change. Repair may be difficult.

Prior to and during the Hippocratic period medical thought had to content itself with the observation and interpretation of surface, bodily phenomena. Different types of individuals were recognized and evaluations were made of their susceptibility or lack of susceptibility to disease. Finally, with the advent and establishment of such changes a prognosis was made possible concerning the outcome of the process. Later, when regulated dissection of the human body was permitted, the anatomists and their offspring, the pathologists, had an opportunity to observe gross organ and tissue changes and attempt to correlate these with the symptoms and signs of disease. Still later, with the development of the microscope these gross changes were found to be a collective reaction, in some instances similar in character, of the cell units in organs and tissues. It is at this point that pathology in general has rested its case. Such observations are essential for the morphological, the anatomical, understanding of disease. They are lifeless reactions. They are no longer a part of the elastic, adapting, living organism as individual. They afford little understanding of those pathological life processes of a chemical order which finally assume such a degree of chemical intensity as to modify cell structure and demonstrate by physical change their chemical presence. Such is the order of the commencement of disease frequently encountered in the middle-aged group of individuals. The pathology, the physiology and pharmacology of the not very distant future will be of a biochemical and biophysical order. Such a concept with the type of research which fits into it and gives understanding to it is necessary if information is to be obtained of the changing, chemical life of tissues as they advance from one age period to another, and as these periods are modified by departures from the normal. With such knowledge these changes within cells of a chemical order can to an extent be regulated and guided. The object of such regulation and tissue guidance is not to prolong life into a useless and likely unhappy senile state, but to conserve and protect it at periods in the life span where it may effectively relate itself in toil as helpfulness for the individual and the family, the economic and social order in which it lives, the industry which it serves or the profession of which it is a part.

The first essential for research is a thought. For the activation and operation of a thought as its validity is tested, financial support is essential. At the present time after man has passed the periods of infancy and childhood and has given up the guidance of the pediatrician, the rest of his life span for which the first was made is permitted to run its course without an understanding of succeeding age periods and therefore without basic guidance. The segments of life as age advances can just as certainly be understood, guided, transitorily stabilized and made increasingly effective as has been demonstrated for the earlier periods. Inquisitive individuals adequately trained with financial support for their undertakings as research will be able to prolong and relate purposefully individuals in the middle-age period of the life span, the life area which at the present time is either terminated abruptly or too frequently prepares the individual for a rapidly advancing state of premature senility. Human conservation of this order is a thrilling adventure and one which challenges the generosity of thoughtful human beings.

OBITUARY

ROBERT ANTHONY HATCHER (1868–1944)

American pharmacologists mourn with family and friends, and realize the great loss their science suffered when, on April 1 of this year, Robert Anthony Hatcher died in his Flushing, Long Island, home.

Dr. Hatcher retired from his Cornell professorship nine years ago, but this formal retirement did not signify either his abandonment of research or his tremendously useful and constructive work on the Council on Pharmacy and Chemistry of the American Medical Association. A tireless enthusiasm for research and a keen awareness of the problems confronting our age remained with Dr. Hatcher almost to his last day. He lived the simple, and outwardly not very spectacular, life of a typical American scientist. He was born in Missouri but spent his childhood in New Orleans. Early in youth he decided to study at the Philadelphia College of Pharmacy. Upon graduation, in 1889, he applied for his first job in a drug store and was told by the proprietor that there were already too many applicants. "Good ones?" inquired Hatcher. He got the job.

He practiced this profession for a time and was a very competent retail druggist. However, filling prescriptions did not satisfy this young Ph.G. He wanted to know more about the action of drugs, so he enrolled as a medical student at Tulane, where he obtained his M.D. degree in 1898. After a hurried trip to Europe, he secured a position in the newly organized Pharmacology Department of Sollmann at Western Reserve. His association with Sollmann was very fruitful for the science of pharmacology. It resulted not merely in scientific papers and a treatise on materia medica, but also in the formation of an intellectual bond between these two zealous advocates of pharmacology. In 1904 he was called to Cornell, where he rapidly advanced to the professorship of an independent department of pharmacology. He taught and toiled at Cornell for over three decades. His association with that institution will be felt for many years to come. During his early residency at Cornell he was also called upon to organize and give the first pharmacology courses at Harvard and Chicago.

Hatcher was not only a great teacher and missionary of pharmacology but was always in the front rank of pharmacological experimentalists. Though there are not many branches of this subject that have escaped his attention, his name will be forever associated with two fields partly created by him—the analytical pharmacology of digitalis principles and the pharmacological study of emesis. His studies on the bioassay, absorption, elimination and mechanism of action of crude and purified digitalis preparations made the rational and effective use of digitalis in heart failure possible. It was the Hatcher-Brody cat unit of digitalis leaf that made accurate, effective and safe dosage possible in the rapid and cumulative methods of digitalis administration. Every patient with congestive heart failure, receiving cardiac glucosides, owes a debt of gratitude to Dr. Hatcher.

It always astonished Hatcher how little the most common symptom of disease, emesis, attracted the attention of physiologists. Since it happens to be one of the most common effects of a large number and apparently unrelated drugs, Hatcher felt that it is the business of the pharmacologist to throw light on emesis and emetics. As a result of his labors in this field we became familiar with the complex paths of the vomiting reflex arc, with the location and the nature of the vomiting center, and with the mode of action of centrally and reflexly acting emetics.

According to the Ostwaldian terminology, Hatcher was a typical classical investigator. He was introspective, detached and attracted only a few intimate personal students and followers. Perhaps only Eggleston, Soma Weiss and Harry Gold can be considered his students in the strict sense, although many pharmacologists worked in his laboratory and were profoundly influenced by him.

As a man, Hatcher was a conservative, unalterably opposed to modern ideas of experimental statesmanship. He dreaded ochlocracy and had little use for politicos whom he suspected of trying to bring it about. And yet, he was a liberal in the best sense of the word. He made no distinction between man and man and looked for a society where merit alone would rule. Some one once asked him how it happened that there were so many immigrants from different racial groups on the staff of his laboratory. "We can't fill all positions with Indians, there aren't enough of them," was Hatcher's terse and innocent reply.

In his later years he became more and more interested in the philosophical background of science. Some of his ideas he committed to writing and they are preserved in manuscript form. He had little use for idealistic philosophy, which he held barren. The conclusions of idealistic philosophers were contradicted by common sense and daily experience in his opinion. Idealistic philosophy reminds one of a puppy chasing its tail—without the fun that the puppy has, he wrote. He agreed with Locke, however, that a rational creature reflecting on the works of creation can not miss the discovery of Deity. Speculating on the nature of mind and intelligence, Hatcher came to the conclusion "that these reached

their highest development in God—who is infinite. God is the only one who has an absolute freedom of will and God's will has a greater velocity of motion than that of light, thus he rules the universe." He contended that only absolute knowledge can mean absolute happiness, and this ideal can only be obtained by God. Man can only approach that ideal, but he can know, if intelligent, that he can contribute something to the ultimate attainment of that ideal by others, by leading the life that wisdom dictates, Hatcher reasoned. At least he must convince himself that he can enjoy the happiness of knowing that he is striving toward the right goal and happiness is achieved in conscientious effort nearly as well, whether successful or unsuccessful. Happiness for the individual man is impossible before he has learned that the greatest good for the greatest number or the greatest truth is superior to his personal happiness, he concluded.

The great pharmacologist has passed into eternity. He advanced knowledge, he alleviated suffering, he worked hard to prevent hostile hands from uprooting pharmacology, that young tender branch of medical science. Belief in the independence of human dignity, in the independence of pharmacology, are the precious heritages of this pioneer of American pharmacology.

THEODORE KOPPANYI

GEORGETOWN UNIVERSITY

DEATHS AND MEMORIALS

DR. WILLIAM SPENCER CARTER, physiologist, dean of the medical faculty, retired, of the University of Texas, died on May 12 at the age of seventy-five years.

PROFESSOR OSCAR M. STEWART, from 1905 until he retired with the title emeritus in 1940 professor of physics at the University of Missouri, died on May 17 in his seventy-fifth year. He was connected with the university for forty-four years.

DR. LESTER S. GUSS, head of the department of chemistry at South Dakota State College at Brookings, president of the South Dakota Academy of Science, died on May 17 in his fortieth year.

CHARLES STEWART BECKWITH, chief of cranberry and blueberry investigations at the College of Agriculture of Rutgers University, died on May 18 at the age of fifty-three years.

THEODORE WILLARD CASE, the physicist, president of the Case Research Laboratory at Auburn, N. Y., died on May 13 in his fifty-fifth year.

JAMES WALLACE BEARDSLEY, consulting civil engineer, retired, who was from 1905 to 1908 director of public works in the Philippines, died on May 15 at the age of eighty-three years.

THE death on October 12, 1943, at the age of sixty-eight years, is announced of Maulsby Willett Blackman, senior entomologist in the division of insect identifications of the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture.

THE hundredth anniversary of the first telegraph message between Washington and Baltimore on May 24, 1844, was celebrated throughout the United States during the week beginning on May 22. At New York University brief ceremonies were held on the site where Professor Samuel Finley Breese Morse demonstrated his invention of the electromagnetic telegraph to a few friends in 1838 before taking it to Washington to interest the Congress. Miss Leila Livingston Morse, granddaughter of Professor Morse, unveiled a temporary tablet (to be replaced when bronze again becomes available) in the Samuel Finley Breese Morse Study Hall on the site where the first instrument was built and demonstrated. Morse memorabilia, including a working model of the original instrument, were exhibited.

SCIENTIFIC EVENTS

THE NATIONAL CHEMICAL EXPOSITION

THE Chicago Section of the American Chemical Society reports that the third National Chemical Exposition, to be held from November 15 to 19 at the Coliseum in Chicago, will not only demonstrate the importance of the chemical industry for the war effort but also for the post-war era. M. H. Arveson is chairman of the committee that is making arrangements for the exposition. The South Annex of the Coliseum has been leased and it is hoped also to acquire the North Hall, but despite the fact that more than twice the area of the two preceding expositions has been made available for exhibitors, there is indication that it may not be possible to provide space for all applicants.

The first exposition held in 1940 at the Stevens Hotel occupied over twenty-six thousand square feet of floor space, and the second in 1942, held at the Sherman Hotel, provided more than thirty-two thousand square feet. Floor space of the coming exposition will exceed fifty-six thousand square feet.

The National Industrial Chemical Conference will meet during the exhibit when authorities on virtually all phases of pure and applied chemistry will appear on the program which is now being arranged by the conference committee. The sessions will be held in the conference hall on the second floor of the South Annex.

Presentation of the Willard Gibbs Medal, founded in 1911 by William A. Converse, will be made during

the meeting. The medal is bestowed each year "in recognition of eminent work in and original contributions to pure or applied chemistry." As reported in SCIENCE last week, it has been awarded this year to Dr. George Oliver Curme, Jr., vice-president and director of research of the Carbide and Carbon Chemicals Corporation of New York City.

THE KENTUCKY ACADEMY OF SCIENCE

THE thirty-first annual meeting of the Kentucky Academy of Science was held at the University of Kentucky, Lexington, on April 28 and 29 The divisions participating were biology, bacteriology, chemistry, geology, mathematics and psychology Thirty-six papers were read at the meetings, which were well attended.

At a symposium on Post-War Planning for Science and Scientific Personnel, the speakers were:

Dr. D B Keyes, Office of Production Research and Development, W.P.B., Washington, D. C

Lieutenant Colonel John D. Kenderdine, Morale Division, A.S.F., Washington, D. C.

H. C. Blankmeyer, Jos. E. Seagram and Sons, Louisville.

Henry T. Heald, president of the Illinois Institute of Technology, Chicago, Ill.

Officers of the academy elected for 1944 45 are:

President, Paul J. Kolachov, Jos. E. Seagram and Sons, Louisville.

Vice-president, Ward C. Sumpter, Western Kentucky State Teachers College, Bowling Green.

Secretary, Alfred Brauer, University of Kentucky, Lexington.

Treasurer, Wm J. Moore, Eastern Kentucky State Teachers College, Richmond.

Representative on the Council of the American Association for the Advancement of Science, A. R. Middleton, Louisville.

Councilor to Junior Academy, Anna A. Schnieb, Richmond.

THE VIRGINIA ACADEMY OF SCIENCE

AT the meeting on May 9 and 10 in Richmond of the Virginia Academy of Science, H. R. Hanmer, director of research for the American Tobacco Company, was elected the twenty-third president of the academy. This is the first time an industrialist has been named head of this organization. Dr. E. C. L. Miller, directing librarian at the Medical College of Virginia, and Dr. Sidney S. Negus, professor of chemistry at the same institution, were reelected secretary-treasurer and assistant secretary, respectively. Dr. Robert F. Smart, professor of biology at the University of Richmond and chairman of the Division of Sciences, was installed as president for the coming year.

A paper on the "Graphical Determination of Complex Roots of the Quadratic" by Clifton B. Cosby, of the United States Patent Office, Richmond, won the Jefferson Prize of $50 for "a meritorious paper presented at the meeting"

Dr. J. Herbert Taylor, a former research fellow of the Blandy Experimental Farm of the University of Virginia, was awarded the Academy Prize, also $50, for his paper on "Cyto-taxonomy and Phylogeny of the Oleaceae, Lindl."

There were three hundred and fifty-four in attendance and one hundred and fifteen papers presented.

THE VAUGHAN RESEARCH AWARDS IN HORTICULTURE

THE American Society for Horticultural Science has established two awards of $500 each for the best papers presented before the society. This was made possible through a gift made by L. H. Vaughan, of Vaughan's Seed Stores, Chicago. One of these awards will be made in the field of floriculture and one in vegetable crops It is expected that they will be continued for at least three years. The following regulations have been adopted:

1. The winning papers must be presented by members of the society to the annual meeting or any one of the recognized sectional meetings and published in the *Proceedings*. Papers by two or more authors will be considered as units Presentation need not be in person.

2. One award of $500 will be made for a paper reporting research in floriculture and one of $500 for one in vegetable crops, provided that if no worthy paper in one of these fields is presented, one of the awards may be made in some other field of horticulture. If no worthy paper appears, no award will be made.

3. Preference will be given to papers that present new discoveries in these fields, showing promise of commercial importance or practical applications.

4. All papers presented during a space of one year following December 1 of each year will be considered for the awards of that year. The winners will be announced at the annual meeting in the following year. (Awards were made at the 1942 meeting for two papers that had been presented and published in the *Proceedings* between December 1, 1941, and November 30, 1943).

5. In making the awards, due consideration will be given to the age, experience and record in research work of the authors. Preference will be given to papers by authors under thirty-five years of age.

6. Judging the papers will be on the basis of (1) originality, (2) soundness, (3) accuracy, (4) clearness and conciseness of presentation and (5) value of the work, especially in its practical applications.

7. These regulations and the committee procedure following are to be considered tentative. They will be adhered to, if possible, for this year.

The award in horticulture in the field of vegetable crops for 1943 has been made to Dr. Henry A. Jones and Dr. Alfred E. Clark, of the U. S. Department of Agriculture, Beltsville, Md., for their paper entitled "Inheritance of Male Sterility in the Onion and the Production of Hybrid Seed," and in the field of floriculture to Dr. L. F. Randolph and Dr. Leland G. Cox, of Cornell University, for their paper entitled "Factors Influencing the Germination of Iris Seed and the Relation of Inhibiting Substances to Embryo Dormancy."

THE NORTH AMERICAN ARCTIC

THE war has focussed attention anew upon North America's last frontier—the Far North. It is inevitable that this attention will grow into deep interest in the post-war years. The development of the areas involved should be based upon careful planning, which in turn demands as a background the best and broadest scientific study that can be brought to bear on the Arctic regions.

A meeting was held in New York City on May 13 to consider the feasibility of establishing a regional North American Arctic Institute with scientific objectives in view. The following men were present:

Major Patrick D. Baird, Ottawa, Canada.
Dr. E. Gordon Bill, Hanover, N. H.
Dr. R. W. Boyle, Ottawa, Canada.
Dr. Charles Camsell, Ottawa, Canada.
Lt. Colonel William S. Carlson, New York, N. Y.
Major Richard F. Flint, New York, N. Y.
Dr. L. M. Gould, New York, N. Y.
A. D. P. Heeney, Ottawa, Canada.
Dr. Diamond Jenness, Ottawa, Canada.
W. L. G. Joerg, Washington, D. C.
Dr. Hugh Keenleyside, Ottawa, Canada.
Dr. Trevor Lloyd, Hanover, N. H.
G. R. Parkin, Montreal, Canada.
Erling Porsild, Ottawa, Canada.
Walter Rogers, New York, N. Y.
Dr. V. Stefansson, New York, N. Y.
Lt. A. L. Washburn, New York, N. Y.
Colonel J. T. Wilson, Ottawa, Canada.
Dr. John K. Wright, New York, N. Y.
Dr. V. C. Wynne-Edwards, Montreal, Canada.

Further consideration of the ideas and suggestions made at the meeting will be given by a small continuing committee. Communications should be addressed to L. M. Gould, 446 East 66th Street, Apt. 2-J, New York 21, New York.

SCIENTIFIC NOTES AND NEWS

THE Sociedad Mexicana de Historia Natural at a meeting held in Mexico City on May 12 conferred honorary membership on Dr. Richard B. Goldschmidt, professor of zoology at the University of California at Berkeley. Dr. Goldschmidt made an address on "Genes and Chromosomes."

THE Ohio State University will confer at its commencement in June the doctorate of science on Thomas Midgley, Jr., vice-president of the Ethyl Gasoline Corporation, president of the American Chemical Society, and on Dr. Arno Carl Fieldner, chief of the Fuels and Explosives Service of the U. S. Bureau of Mines.

RUSSELL SAGE COLLEGE at its twenty-seventh commencement exercises on May 14 conferred the doctorate of science on Dr. Katharine B. Blodgett, research physicist of the General Electric Company.

THE degree of doctor of science was conferred at the sixty-sixth annual commencement of Smith College on Sophie Satina, research associate in cytogenetics in the department of botany.

THE Howard Taylor Ricketts Prize of the University of Chicago has been awarded to Dr. Paul Everett Thompson, of the university, in recognition of "outstanding research on malaria."

THE Bessemer Gold Medal for 1944 of the British Iron and Steel Institute has been awarded to Essington Lewis, director-general of munitions and of aircraft production for Australia, "in recognition of his outstanding services to the iron and steel industry of Australia."

DR. WARFIELD T. LONGCOPE, professor of medicine in the School of Medicine of the Johns Hopkins University, was elected at the Atlantic City meeting president of the Association of American Physicians.

GEORGE F. BATEMAN, dean of the Schools of Engineering of Cooper Union, has been elected president of the New York Electrical Society; Dr. Colin G. Fink, professor of electrochemistry at Columbia University, first vice-president, and Dr. Ernst Weber, research professor in electrical engineering at the Polytechnic Institute of Brooklyn, second vice-president.

DR. CHARLES R. DOWNS, consulting chemical engineer, has been elected president of The Chemists Club, New York City. He succeeds Carl Raymond DeLong.

DR. SANFORD S. ATWOOD, who has been associated with the U. S. Regional Pasture Research Laboratory at the Pennsylvania State College since 1937, has become assistant professor in the department of plant

breeding of Cornell University, where he will conduct cytogenetic and breeding investigations with forage crops. Dr. Atwood took up the work on May 1.

DR. MARION MURPHY BROOKE, associate in parasitology at the School of Hygiene and Public Health of the Johns Hopkins University, has been appointed associate professor of preventive medicine at the School of Medicine at Memphis of the University of Tennessee.

WALTER FITZGERALD, senior lecturer of the University of Manchester, England, has been appointed professor of geography to succeed Professor H. J. Fleure, who retires in September.

DR. ROBERT C. MILLER, director of the California Academy of Science, Golden Gate Park, Calif., has been elected secretary of the Pacific Division of the American Association for the Advancement of Science in succession to Dr. J. Murray Luck, professor of biochemistry at Stanford University, who has resigned as of June 30. After July 1 all communications pertaining to the Pacific Division should be directed to Dr. Miller at the above address.

FOLLOWING the recent reorganization of the various departments of the Library of Congress, Frederick E. Brasch, formerly chief of the Smithsonian Division, has been advanced and now assumes the title of consultant in the history of science.

DR. MARSTON TAYLOR BOGERT, professor emeritus of organic chemistry at Columbia University, was reelected president of the Supervisory Board of the American Year Book at its annual meeting in New York on May 16. This board is composed of representatives of forty-six national learned societies, which cooperate in the editing of this annual record of events and progress.

DR. GEORGE H. YOUNG has been appointed executive assistant of the Mellon Institute of Industrial Research, Pittsburgh. He has been associated with the institute since 1935, first as industrial fellow, then as senior fellow, on the Stoner-Mudge, Inc., Multiple Industrial Fellowship on Protective Coatings. He will take up the management of the research programs of the institute on June 1. During the past three years he has been occupied almost exclusively with problems closely connected with the war effort.

DR. HENRY C. SHERMAN, chief of the Bureau of Human Nutrition and Home Economics of the U. S. Department of Agriculture, has resigned effective in June and will return to his professorship at Columbia University. He will be succeeded at the bureau by Dr. Hazel K. Stiebeling, now assistant chief.

DR. HARVEY N. DAVIS, director of the Office of Production Research and Development of the War Production Board since 1942, has submitted his resignation to take effect on June 1, when he expects to return to his work as president of the Stevens Institute of Technology.

THE *Journal* of the American Medical Association reports that Major General Norman T. Kirk, Surgeon General of the Army, has appointed five science writers as civilian consultants. The men, who are also members of a subcommittee of the Division of Medical Sciences of the National Research Council and members of the National Association of Science Writers, are David Dietz, science editor, Scripps-Howard Newspapers, Cleveland; James C. Leary, science editor, Chicago *Daily News;* Robert D. Potter, science editor, *American Weekly,* New York; Lawrence C. Salter, associate director of press relations, American Medical Association, Chicago, and William L. Laurence, science news editor, *The New York Times.* These writers will work with the Surgeon General and his staff in the preparation of information for the public on new developments in medical research in the Army.

PROFESSOR L. W. BUTLER, of the department of physics of the Iowa State College, has leave of absence to enable him to take up research on naval equipment at the Naval Ordnance Laboratory in Washington.

R. J. KOWAL, of the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, has been assigned to Barro Colorado Island in the Canal Zone to make a series of tests relative to the injection of chemicals into the sap stream of living trees to determine the effectiveness of this method to protect tropical wood from termites.

WILLIAM C. COOPER, of the Office of Foreign Agricultural Relations, is visiting the Cooperative Experiment Station at Tingo María, Peru. While there he will conduct agronomic studies in connection with the complementary-crops program.

SEÑOR EMILIO PINEL, professor of physics at the University of Honduras and professor of agriculture at the Tegucigalpa High School, recently arrived in the United States as the guest of the Institute of Inter-American Affairs to study the organization of field centers of the U. S. Department of Agriculture. Señor Pinel was recently appointed director of agriculture of the Republic of Honduras.

DR. LOYAL DAVIS, professor of surgery at the Medical School in Chicago of Northwestern University, gave the annual Walter L. Niles Memorial Lecture at Cornell University Medical College on May 18. He spoke on "Experiences as Consultant in Neurological Surgery in the European Theater of Operations."

DR. T. M. SONNEBORN, of the department of zoology of Indiana University, spoke on April 27 before the Science Club of Vanderbilt University on "The Structure of the Gene and the Nature of Gene Action in Relation to Work on Paramecium."

DR. HUGH STANNUS delivered on April 18 and 20 the Lumleian lectures of the Royal College of Physicians, London. He discussed problems in riboflavin and allied deficiencies.

THE twenty-fifth annual meetings of the American Geophysical Union and of its eight sections will be held in the Hall of Government, George Washington University, Washington, D. C., on June 1 and 2, and on June 3 a joint meeting with the Section of Seismology and the Eastern Section of the Seismological Society of America.

THE *Journal* of the American Dental Association announces that, as a result of new regulations of the War Department, dental schools throughout the country will suffer a fifty per cent. reduction in the Army quota of students scheduled to enter next year.

IT is reported that Kemper K. Knapp, a lawyer of Chicago, who died on February 23, bequeathed "in excess of $1,000,000" to the University of Wisconsin. He indicated a wish that part of the fund be used for scholarships in the undergraduate or law departments for graduates of Illinois and Wisconsin high schools.

ACCORDING to the will of the late Dr. Charles W. Burr, professor emeritus of mental diseases of the School of Medicine of the University of Pennsylvania, the sum of $200,000 is bequeathed to the endowment fund of the university. His library of about 19,000 volumes is also left to the university.

THE *Journal* of the American Medical Association reports that fellowships in graduate health education leading to a master of science degree in public health are being offered by the U. S. Public Health Service through funds made available by the W. K. Kellogg Foundation. The training provides nine months in academic work in public health and public health education and three months of supervised field experience. A stipend of $100 per month is provided for twelve months, free tuition and travel for field experience. Candidates must pay their traveling expenses to and from the university at the beginning and end of training. Fellowships, which will be available for the fall quarter of 1944, are extended at this time only to qualified American women between the ages of nineteen and forty. Men can not be considered because of the demand for manpower for military service. Qualifications should include a bachelor of science degree or its equivalent from a recognized college or university. Additional information may be obtained from the Office of the Surgeon General, U. S. Public Health Service, Washington 14, D. C. Applications must be accompanied by a transcript of college credits and a small photograph, and must be received not later than August 1.

THROUGH the development of a new American War Standard-Coordination of Graphical Symbols for electrical and electronic equipment, a consistent set of symbols has been issued by the American Standards Association. Previously one symbol was sometimes used to indicate two different pieces of apparatus, and in some cases two different symbols meant the same thing. This standard, in the development of which many national groups and representatives of the Armed Forces cooperated, is admittedly a compromise.

AT the Scientific Exhibit to be held at the Palmer House in connection with the meeting in Chicago of the American Medical Association, emphasis will be placed on war medicine with exhibits from the Army and the Navy. Special exhibits include fractures, the treatment of burns, chemotherapy, infectious diseases and rehabilitation. There will also be a group of exhibits on tropical medicine, and lectures and conferences on rheumatic fever and heart disease.

THE *Journal* of the American Medical Association reports that a cancer control foundation has been established in Ontario. A legislative appropriation of $500,000 will assist in its support. The foundation has been empowered to acquire lands and buildings and to employ a director, officers and the necessary clerical staff. Lieutenant Colonel A. L. Bishop, Toronto, is chairman of the foundation. Other members include Arthur Ford, London; Dr. George S. Young, Toronto; Malcolm Cochrane, Port Arthur; Robert Brown, Toronto; R. E. Stratford, Sarnia, and Kenneth Emerson Deacon, Unionville.

A WHITE paper issued by the British Government on April 6, as reported in *The Times*, London, gives an account of the Government organizations which are concerned with research and development related to the problems of industry. For fundamental research and for the education of research workers, responsibility largely rests with the universities. For these purposes assistance is given by the government. There are now in existence in Great Britain more than twenty agricultural research institutes and stations covering a wide variety of subjects. Most are not owned or managed directly by the State; some are attached to the universities, and others are owned by associations representing branches of the agricultural and horticultural industries. The Minister of Agriculture and the Secretary of State for Scotland have recently set up new machinery designed to ensure

that the results of research are applied as rapidly as possible in farming. The agricultural improvement councils appointed by these ministers will keep in close touch with experiments in new farming methods and will advise, after testing, on their introduction into ordinary farming practice.

DISCUSSION

INTERPENETRATING CLIMAXES IN QUEBEC

AN accurate mapping of the climax areas of vegetation is possible to date only in the North Central States. Phytosociological work in New England, Quebec, Ontario and the Maritime Provinces is still fragmentary. The general limits of the Canadian forest (*piceetum*), of the lake forest (*tsugetum*) and of the oak-hickory forest (*quercetum*) are fairly well known. But their ultimate reaches in the Northeast have not been thoroughly investigated.

Recent exploration has revealed that the sugar maple community extends quite to the tip of the Gaspé Peninsula. It is absent from the immediate coastline all the way from Saint-Jean-Port-Joli, but occupies the hinterland in a more or less continuous strip on the foothills. It is true that beech (*Fagus grandifolia*) drops out at the beginning of the peninsula, but these maple woods are otherwise typical, with *Acer saccharophorum, Betula lutea, Acer pennsylvanicum, Cornus alternifolia, Dicentra Cucullaria*, etc. It is also noteworthy that, when tapped, they seem to yield an average quantity of sugar.

This poses the question of interpretation of interpenetrating climaxes. Potzger and Friesner[1] have shown that, in Indiana, conditions can be such that the more "favorable" sites will be occupied by the mesophytic *aceretum*, and the less favorable but topographically mature will be colonized by the *quercetum*. It may be that such circumstances prevail in the Gaspé in reference to the *aceretum*, occupying the sheltered, well-drained foothills, whilst the more hygric *piceetum* dominates elsewhere.

Again, north of Lake Saint-Jean, the same relationship obtains between the boreal forest and the taiga or hudsonian zone. The new road built by the Aluminum Company of Canada to its barrage at Passes Dangereuses (latitude 50° N) offers a good cross-section through virgin forest. At about latitude 49°, one can witness the contact of three climaxes: (1) immense stretches of very typical Canadian forest; (2) isolated stands of taiga; (3) restricted stands of deciduous forest. The last true maple grove occurs at Metabetchouan, on the shores of Lake Saint-Jean itself. Gradually the typical elements fall out: *Acer saccharophorum* a few miles north of the lake, *Acer rubrum* 20 miles, and finally *Betula lutea* 38 miles. The last named, with hardly any admixture of fir (*Abies balsamea*), forms pure stands at the aforementioned point of contact.

Just what climatic interpretations are warranted by the distribution of these phytosociological groups in the Province of Quebec? There is some evidence that our climate is getting colder and moister (Cooper,[2] Sears[3]), at least in the east (Griggs,[4] Raup[5]). The distribution just outlined is certainly consistent with that theory. Also the existence in the Gaspé Peninsula of a few isolated and evidently relict colonies of red oak (*Quercus borealis*[6]) seems to indicate formerly warmer and drier conditions. It is not unlikely that species of wide midland distribution, such as *Hamamelis virginiana, Celtis occidentalis, Andropogon furcatus, Sorghastrum nutans, Camptosorus rhizophyllus* and others apparently introduced through the Ottawa Valley, are equivalent in Quebec to prairie relicts in Ohio and Indiana[7] and owe their extension to a former period of reduced precipitation. There is evidence also that the "lake forest" reached much further to the north and east, since *Tsuga canadensis* once occurred at Matamek,[8] several hundred miles beyond its present distribution.

Interpenetrating climaxes therefore may be indicative of former conditions and their moving borderlines are likely to follow the fluctuations of climatic trends. The relative vitality within a given area and on comparable topography and soil of the elements respectively characteristic of each climax is an indication of the immediate trend of the locality. It has been shown, in Alaska,[9] for instance, that local factors can be active in a sense (warming or cooling) opposite to the general trend.[10]

Many factors, therefore, must be taken into consideration to correctly interpret the present pattern of vegetational types in Quebec. The first is cohesion of the climax complex. Of course, the climax association, for instance, *Aceretum saccharophori*, on the edge of its range in Gaspé and Lake Saint-Jean, tends to disintegrate. It can still be said to represent the climax association, however, as long as it is not conspicuously invaded by the elements of the neighboring

[1] J. E. Potzger and R. C. Friesner, *Butler Univ. Bot. Stud.*, 4: 181–185, 1940.

[2] W. S. Cooper, *Jour. Geol.*, 50: 981–994, 1942.
[3] P. B. Sears, *Bot. Rev.*, 8: 708–736, 1942.
[4] R. F. Griggs, SCIENCE, 95: 515–519, 1942.
[5] H. M. Raup, *Jour. Arn. Arb.*, 18: 79–117, 1937.
[6] E. Campagna, *Ann. de l'Acfas*, 5: 104, 1939.
[7] N. E. Transeau, *Ecology*, 16: 423–437, 1935.
[8] Paul W. Bowman, *Ecology*, 12: 694–708, 1931.
[9] R. F. Griggs, *Ecology*, 15: 80–96, 1934.
[10] W. S. Cooper, *Ecol. Monogr.*, 12: 1–22, 1942.

climax, the *piceetum*. In other words, it is true *aceretum* if the climax elements are still dominant, in number of species and in abundance of individuals. This seems to be the case for the Gaspé stands of deciduous forest.

Second is vitality. Do these aforementioned elements tend to complete their cycle and development? With as great relative success as in the optimal area? Again this is so in the Gaspé *aceretum*.

A third factor, of more delicate interpretation, owing to the lack of available data, is the possible position of climax associations as pre-climax or post-climax outside their optimum range, as suggested by Cain[11] and Potzger and Friesner[12] in relation to *quercetum* and *aceretum* in Indiana. It is not unlikely that in Quebec stands of "lake forest," for instance, on the sandy soils at the mouth of the Richelieu, are pre-climax to the maple grove or possibly even subclimax. It may be that deciduous forest in Gaspé is pre-climax to the more generalized spruce-fir (*piceetum*). The southernmost islands of taiga mentioned above might also be considered as post-climax, since they are—under a scarcely modified form—subclimax farther south, in the hydrosere.

Surely the southern edge of the laurentian shield presents a fairly complex vegetational pattern. It has most often been considered an "ecotone." However, to one who is familiar with that pattern, it appears much more as a mosaic of associations than of species. What is meant here is that, for instance, the deciduous forest and the Canadian forest on their points of contact may interfinger over fairly large areas, but in any given stand, each community remains distinct: the species themselves do not ordinarily mingle. That is also true, although to a lesser degree, of the later seral stages. For instance, white pine and hemlock seldom if ever occur on the climax site of spruce-fir forest, as they are subclimax to the deciduous forest.

In any case, it seems doubtful here if the designations pre-climax and post-climax will serve any useful purpose if two climaxes interpenetrate over an area several hundred miles wide. It may be better to recognize the permanence of two separate climaxes over a varied topography that allows, however, of no physiographic evolution rapid enough to overcome climatic change itself.

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[11] S. A. Cain, *Am. Midl. Nat.*, 21: 146–181, 1939.

[12] Potzger and Friesner, *l.c.*

THE GENERIC NAME OF THE SAND FLY

IN his statement published in SCIENCE for April 28, 1944, your correspondent, W. F. Rapp, Jr., has completely overlooked the reason for the emended spelling, *Phlebotomus*, commonly applied to the sand flies, otherwise known as *Flebotomus*. All codes of nomenclature provide, of course, that the spelling of every generic name be that used by the author in his original publication where the name was first proposed. Specific exception is made, however, where it is evident that the original spelling includes a typographical error and permission is given to correct such mistakes in later publications.

Rondani used *Flebotomus* in designating the genus in 1840, but the derivation of the name is so obvious (from φλεβός, vein and τομή, cutting) that Agassiz and most later zoologists have emended the spelling to *Phlebotomus*, using the corrected Latinized form. Thus, the change has been made to correct a very evident typographical error, and not for reasons unknown, nor "to make it easier to pronounce," as suggested by Dr. Rapp. A further reason to invoke the provision of the code concerning the correction of typographical errors lies in the common and long-standing use of the combining form *phlebo-* in a series of common medical terms referring to veins, blood, blood-letting, etc. Also the term phlebotomic or its close counterpart is regularly applied to the blood-sucking insects in English and in the other more widely used European languages.

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ISOLATION OF ERGOSTEROL FROM PENICILLIUM NOTATUM

DURING the course of the determination of the hydrocarbon content of plants as part of work on the origin of petroleum,[1] we have studied *Penicillium notatum*, grown for the production of penicillin. The non-saponifiable matter from a butanol extract of the wet mycelium produced an easily purified sterol which has the distinctive properties of ergosterol; m.p. 160–162°, $[\alpha]^{25}_{D}$ -126[2a]. Acetate, m.p. 171–174°, $[\alpha]^{25}_{D}$ -90[2b]. Benzoate, m.p. 165–167°, $[\alpha]^{25}_{D}$ -64[2c]. The amount of ergosterol isolated approximated 1 per cent. of the dry weight of the mycelium, although maximum recovery was not attempted. Ergosterol has been isolated from yeast, ergot and a variety of fungi. It will be recalled that the irradiation of ergosterol yields vitamin D_2, calciferol.

We wish to thank the Department of Bacteriology of the School of Agriculture and the War Production Board Penicillin Project for the material studied.

[1] American Petroleum Institute Research Project 43b.

[2] (a) Purified hydrated ergosterol melts at 160–163°, $[\alpha]^{20}_{D}$ -128.7, Callow, *Biochem. Jour.*, 25: 79, 1931. (b) Acetate, m.p. 179–180°, $[\alpha]^{20}_{D}$ -90, Bills and Honeywell, *Jour. Biol. Chem.*, 80: 15, 1928. (c) Benzoate, m.p. 168–170°, $[\alpha]^{20}_{D}$ -70.5, Wieland and Asano, *Ann.*, 473: 300, 1929.

Our thanks are due to our former colleague, Russell E. Marker, now in Mexico, for the methods used.

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UNUSUAL MORTALITY AMONG GEOLOGISTS

DURING the slightly over five months ending April 19 no less than sixteen fellows of the Geological Society of America have died. Only twice in the entire fifty years of the society's history has the entire annual loss of its personnel been as heavy as in this five-month period. Never has the distinction of the deceased fellows been so outstanding. The list follows:

	Date of death		Age
	1943		
Frank Leverett	November	15	84
H. L. Fairchild	"	29	94
	1944		
G. O. Smith	January	10	73
E. B. Mathews	February	4	74
Arthur Keith	"	7	79
F. G. Clapp	"	18	65
E. O. Ulrich	"	22	86
Douglas Johnson	"	24	66
R. E. Dickerson	"	24	66
J. A. Taff	March	8	81
H. A. Buehler	"	14	68
B. L. Miller	"	23	69
H. L. Smyth	April	8	81
H. N. Eaton	"	12	64
F. C. Schrader	"	16	83
R. C. Wells	"	19	66
	Average		74.5

This list includes our foremost glacial geologist (Leverett); three former presidents of the Geological Society of America (Fairchild, Keith and Johnson); a former director of the U. S. Geological Survey (Smith); a Penrose Medallist (Ulrich); four members of the National Academy of Sciences (Leverett, Keith, Ulrich and Johnson) and two of the American Philosophical Society (Leverett and Johnson).

Three other geologists not fellows of the society died within the same period. They were George Steiger, who died on April 18 at the age of 74, R. C. Wells, who died on April 19 at the age of 66, and F. B. Hanley, who died on April 24 at the age of 45.

Can these losses, notwithstanding the ripe age of the men, be regarded as war casualties? Some we know have been called back into strenuous active service, and all have probably suffered disillusionment by reason of the world catastrophe with its destruction of cultural institutions and values, to which their lives have been devoted. Few have been without close friends or relatives in supreme danger on the fighting fronts.

WM. H. HOBBS

THE PAPER SHORTAGE AND SCIENTIFIC PUBLICATION

WARTIME limitations of paper are making serious difficulties for our scientific periodicals, and the paper shortage is more likely to increase than to diminish.

Three adjustments are possible: (1) Scientific journals might be officially recognized as of greater value than, say, newspapers, and so obtain higher priorities; (2) there could be a drastic curtailment of publication; (3) better printing, editing and other means could secure publication of substantially the present material in less space.

Doubtless scientific publications are more valuable than much of the stuff that is printed in the popular newspapers and magazines. But it is altogether unlikely that scientific journals could compete with popular magazines in bringing pressure on allocating authorities.

Drastic curtailment in the publication of scientific results would be a calamity to the nation. As a matter of fact, the paper shortage merely brings to a head a crisis in scientific publication which has been long developing, and it is high time that it be given careful consideration. The effectiveness of scientific investigation is menaced by increasing difficulty and delay in publication. Prior to this present squeeze in paper the chief difficulty has been due to rising costs which compelled restriction of output with consequent congestion until papers often become almost obsolete before publication. Nothing is more important to the advance of science than the prompt interchange of results. This has been accomplished by printing, but present conditions have fostered other and quicker modes of diffusion. These should be stepped up in frequency and in effectiveness.

The easiest method for prompt dissemination of results is by the exchange of manuscripts within the small circle of workers known to be actively concerned. This gives insiders a great advantage. During the war when much is secret, outsiders have little chance of making useful contributions. No one doubts the necessity for secrecy in war research, but science advances mostly through the stimulation of mind on mind. The chief function of technical societies is to keep their members abreast of progress, and desire to keep up with developments is the principal motive for maintaining membership. In elementary self-interest, therefore, a technical society ought to be alert for every means of increasing its usefulness to its members.

Some societies distribute advance abstracts of the papers offered at their annual meetings. Not infrequently these appear more than a year before the papers themselves are printed. Authors and program makers should take great pains to improve abstracts.

Many of those published at present leave much to be desired. Often a list of procedures rather than a summary of results and conclusions is offered. But there is no reason for restricting advance abstracts to papers which are to be read at meetings. This is especially true in these days when meetings are curtailed. Why not publish an abstract of every paper as soon as it is received?

Microfilm or other copies of manuscripts awaiting publication could readily be made available immediately upon receipt of a paper. Much could be done by building up notification services linked with advance abstracts so that interested people would be apprised promptly of completed researches. If editors would publish "Advance Abstracts of Papers Received and Available in Microfilm" in every issue of their journals, I venture to predict that readers would habitually turn to this section of the journal before reading anything else.

Abstracts should be published immediately upon receipt of a paper, before decision was reached whether or not to print it (except for papers obviously unsuitable for the journal concerned). Whatever the editor may think of a paper, the writer is ready to have it broadcast, and immediate distribution would be highly desirable to both author and editor—in more ways than one. The circulation of copies privately would promote discussion and criticism which would greatly lighten editorial work, providing what would amount to a wider circle of referees than are now consulted. More extended criticism would cause authors to revamp and improve their papers, and the journals would benefit greatly.

Wide prepublication circulation of results would permit editors to view their tasks from a point of view entirely different from that which they must now take. One often hears it said of some of the most valuable scientific papers that they will be used by only a dozen men anyway and the opinion of the rest doesn't matter. If, now, the dozen people who would actually use the paper had already read it, there would be less need of publishing it in full. Under these circumstances the editor's job would be to publish such a condensation of the manuscript as would be useful or interesting to the majority of his readers. Copies of the original would still be available to all who need the details, and could be cited like published papers.

A concrete illustration of the service that advance abstracts could render to science will be useful: There has been discussion between British and Americans as to the proper daily allowances of certain vitamins. The British, perhaps unduly influenced by short supplies, have felt that their people could get along on one third of the American allowances. Some Americans have been fearful of the consequences to the English people. Decisions on both sides had been reached on the basis of inference from indirect evidence. In reviewing the situation a consultant alluded to a paper, referred to him by an editor, which gave the results of an experiment on human beings and fixed the needed level of intake. The authors promptly supplied a copy, and their researches began immediately to bear fruit.

Two months later a casual telephone conversation revealed the fact that the Office of the Quartermaster General was worrying about the same problem. They had not heard of the research, which was still unpublished. Again, because of knowledge possessed only accidentally, and only accidentally transmitted, the application of science was speeded up.

Four months later the paper was published, considerably recast and improved. This improvement was an important gain to both author and journal. But immediate use of the results was important. An advance abstract, making everybody aware of what was going on, would have saved at least three months time in an important war service.

Many times nowadays cost of printing compels editors to delete data essential to those doing related researches. Conversely, much material of no interest outside a small circle is published merely because this small group must have the material if research is to move forward. If editors knew that such data were already in the hands of those who would use them, or were readily available, they could then proceed to increase the utility of their journals to the general run of their readers. Perhaps this might permit sufficient condensation of the material published to pay for the microfilm or photostat copies needed by specialists. It would increase reader use and appreciation, and so, circulation—again, in turn, easing financial problems.

The wartime necessity for contracting publication can, in fact, be a blessing in disguise. Most people feel that much material—always, of course, other people's copy—appears in the scientific journals which should be edited out. Most editors would do more and better editing if they had the courage that their judgment dictates. Nevertheless, few scientific men realize how much improvement more and better editing could bring about. Authors who finally manage to "get their papers off" are stale and unable to go further in their presentation. After the author has done all he can to a paper, it can be improved by another hand. I remember when a friend of mine took a position on the staff of one of the leading magazines he told his chief, "I can write and I can edit, but one thing I can not do is to edit my own copy." The services of a good editor, though seldom enjoyable, are of inestimable value to any author. The most skilful of writers are no exception. One of the best of these once wrote a letter to the *Reader's Digest* somewhat in this wise, "I thought it was all well enough for you to

compress the work of ordinary writers into a third of the space it took originally, but I write carefully, weighing every word, and I knew that no such liberties could be taken with my stories without destroying them. I was, therefore, indignant when I heard you had done it also to me—but I must confess that you improved my work."

The most notable event among the popular magazines of the last decade has been the phenomenal success of the *Reader's Digest,* which has not only outstripped in popularity all the old-line magazines in its general field, but has driven several of them to the wall. Indeed, some of those magazines which survive do so only from the proceeds of abstracting rights sold to the *Reader's Digest.* It is noteworthy that the advertising carried by the old-line magazines does not suffice to save them. It would be worth while for the scientific journals to study the factors in the success of the *Reader's Digest.*

If one takes the trouble to compare the abridged articles of the *Reader's Digest* with their originals, he finds not only that often nothing has been lost by abbreviation, but that frequently something has been gained. Could research papers be improved by similar treatment? For the most part, I believe that they could except for the few investigators in cognate fields who must have detail. Skilful editing by one closely in touch with the science concerned could solve the problems of many a journal.

Another strong factor is operating to compel condensation of scientific publication. No man can read all the material published even in a small field. If the volume of publication is reduced, there will be better support for what remains.

After the editor has done his work, still further economies (and improvements) can be made in type and format. Scientific periodicals have made very great progress toward better printing in the last decade. But there are still very great differences in the printing of scientific publications. Study of the organs of the member societies of the Division of Biology and Agriculture of the National Research Council reveals that some of them get three times as much print onto a square foot of paper as others. Clearly a good deal of improvement could be made here.

Recent researches into the visual task imposed by reading point the way to further improvements beyond the best of our scientific serials to-day. Matters concerning type and format, however, can not be profitably discussed within the limits of this paper. The means of meeting congestion and delay in publication here advocated are, however, independent of typography or format. It is believed an effective advance notification service would permit substantial contraction (without loss to science) of published papers. This would be brought about by prompt publication of advance abstracts of researches as soon as completed accompanied by wide availability of copies, by microfilm or otherwise, of the manuscripts to those directly concerned.

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SCIENTIFIC BOOKS

CHEMISTRY

Organic Chemistry for the Laboratory. By C. W. PORTER and T. D. STEWART. vi + 222 pp. $5\frac{1}{2} \times 9$ in. The Athenaeum Press. Boston, New York, etc.: Ginn and Company. 1943. $2.00.

THIS little manual has been prepared as a guide for an introductory laboratory course in organic chemistry. As the authors explain in their preface, the manual provides for work extending through a period of one year, but it is particularly designed for a half-year course of thirty to forty laboratory periods. The manual is divided into four sections: I. General Directions; II. Experiments; III. Mechanical Operations; IV. Appendix. The first section is very brief (5 pp.), and the next section (154 pp.), comprising theoretical discussions and laboratory procedures for some fifty experiments, divided about equally between aliphatic and aromatic compounds, constitutes the main part of the manual. After the first three experiments, "Distillation," "Crystallization" and "Qualitative Tests for the Elements," the experiments are largely of the preparative type and similar in nature and arrangement to those that are to be found in other organic laboratory manuals. Optional procedures and short "reaction" experiments frequently follow the preparation directions. The latter are quite explicit in the earlier experiments and are given in more general terms as the student advances. Most of the experiments end with a set of five or six suggestive and helpful problems. The experimental section is concluded with a very brief discussion and series of tests on "The Classification and Identification of Compounds."

The third section (51 pp.) presents a simple and straightforward discussion of the theory and principles underlying the following mechanical operations: "Distillation," "Extraction," "Filtration," "Crystallization," "Sublimation," "Determination of Boiling Point," "Determination of Melting Point," "Calibration and Use of Thermometers" and "Methods of Dry-

ing." The discussion includes a brief review of the apparatus that is used in each operation. The Appendix (4 pp.) includes the methods of preparing the various indicators, reagents and solvents used throughout the manual.

The reviewer feels that the manual is a worthy companion to the text "Organic Chemistry" by Porter and Stewart (Ginn and Company, 1943) and that it should be very useful in an elementary organic course of the type for which it has been designed. The diagrams throughout the manual are entirely adequate, and the paper, press work and binding are very good.

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Second Year College Chemistry. By W. H. CHAPIN and L. E. STEINER. New York: John Wiley and Sons, Inc. Fifth edition. 575 pages. 1943. $3.75.

SCHOLARLY additions by the junior author give this text better balance of subject-matter than its predecessors. Although sequence of topics remains the same, much material appears for the first time. This includes a more rigorous correlation between the physics and chemistry of liquids and of solids; new mathematical derivations inserted in smaller type for the abler student; 165 miscellaneous problems in the appendix; crystal structure with splendid diagrams and an excellent discussion of ionic and covalent radii; mathematical derivation of the law of radioactive decay; descriptive material on tracer isotopes; and a detailed treatment of the Brønsted system of acids and bases.

The preface states that "the kinetic point of view is maintained throughout." For this reason it might have been advisable to include such subjects as reaction rates and the simpler aspects of quantum and statistical mechanics and the use of potential energy curves in this otherwise well-rounded, valuable text.

HUBERT N. ALYEA

PRINCETON, N. J.

General Chemistry. By HORACE G. DEMING. New York: John Wiley and Sons, Inc. Fifth edition. 706 pages. 1943. $3.75.

COMPLETELY rewritten, the new edition still emphasizes physical chemistry aspects, an approach for which Professor Deming has gained a worthy reputation. As such the treatment should appeal particularly to students in engineering. Rearrangement in order of topics has been extensive, with chapters on the atmosphere, the periodic table, atomic structure and pH appearing much earlier than in the fourth edition. Discussion of principles is curtailed somewhat to provide room for approximately a hundred pages of new material on industrial chemistry in the war effort: plastics, elastomers, ceramics, hydrogenations, light metals, detergents, and so forth. Once again the author has given us a top-notch, up-to-the-minute text.

HUBERT N. ALYEA

PRINCETON, N. J.

AUDIOMETRY

Clinical Audiometry. By C. C. BUNCH. Pp. 186. Illustrated. St. Louis: The C. V. Mosby Company. 1943. $4.00.

This is an intensely personal account of the author's life work—the development and use of the audiometer and the obtaining of countless audiograms. The sudden and untimely death of the author, just after completion of the manuscript, probably accounts for the frequent repetitions, quick digressions and returns that might have been eliminated in a final "polishing off."

The point of view of the book is highly specialized and does not extend far into any of the related fields of physics, physiology, psychology or clinical otology. For example, the author does not accurately explain or define the decibel, although it is now the accepted unit of measurement of hearing loss.

It is surprising, also, that no mention is made of the calibration of an audiometer, or of the range of variation of "normal" thresholds, or of possible differences in calibration of different commercial instruments.

In spite of its shortcomings, however, the book will remain a valuable record of the development of audiometry and of Dr. Bunch's extensive acquaintance with human auditory function.

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REPORTS

DOCTORATES IN SCIENCE[1]

BOTH the total number of doctorates granted in all fields of knowledge, including the sciences, and the total granted in the sciences alone reached an all-time high in the 1940–41 academic year. In all fields together the decline was about 9 per cent. from 1941 to 1942 and 17 per cent. from 1942 to 1943. In the group of the sciences alone, the decline was about 10 per cent. from 1941 to 1942 and 16 per cent. from 1942 to 1943. These figures are surprisingly uniform. They reflect an interestingly stable relation between the sciences as a group on the one hand and the social sciences and humanities as a group on the other. For

[1] Based upon "Doctoral Dissertations Accepted by American Universities, No. 10, 1942/43." New York: H. W. Wilson Company. 1943.

all doctorates granted in the last ten years, the median has been 56.6 per cent. in the sciences and 43.4 per cent. in the social sciences and humanities. The maximum variation either way in any one year was less than 2 per cent.

Full tables of science dissertations for the nine years from 1934 to 1942 were printed in SCIENCE a year ago (97: 333–5). We will not repeat them. We show here only the figures for the past three years in which the decline has been taking place. Table 1 is arranged in order of the 1943 ranking of the various sciences.

TABLE 1

	1941	1942	1943
Chemistry	672	588	538
Biochemistry	116	138	129
Physics	191	146	124
Zoology	125	110	103
Psychology	117	125	95
Botany	102	120	89
Agriculture	78	55	61
Bacteriology and microbiology	71	69	56
Physiology	77	66	49
Mathematics	95	85	44
Geology	53	56	36
Entomology	46	44	32
Pharmacology	31	31	29
Genetics	31	23	29
Engineering	76	47	22
Horticulture	23	21	14
Astronomy	11	7	14
Metallurgy	17	11	13
Anthropology	19	14	12
Geography	16	16	10
Anatomy	18	16	10
Medicine and surgery	18	15	10
Public health	15	14	6
Mineralogy	3	6	4
Paleontology	11	6	3
Meteorology	1	3	2
Seismology	1	1	1
	2034	1833	1535

Chemistry and its near-twin biochemistry lead the group in 1943, biochemistry having for the first time taken the lead over physics, which has been in the second place for several years. Chemistry, however, is increasing steadily in relation to all other doctorates granted. In 1939 it was 16 per cent. of the total. In 1940 it was 17 per cent.; in 1941, 18 per cent.; in 1942, 19 per cent., and in 1943, a full 20 per cent. It now totals more than a third of all science doctorates granted in 1943. If biochemistry were to be added in, the percentage would be still higher.

It might be interesting to observe what universities gave 25 or more doctorates in the sciences as a group in 1943.

TABLE 2

1.	Minnesota	91	12.	Iowa State	47
2.	Cornell	87	13.	Massachusetts Institute of Technology	47
3.	Wisconsin	84	14.	Harvard	39
4.	California	74	15.	Pennsylvania	31
5.	Columbia	71	16.	Maryland	27
6.	Chicago	58	17.	New York	27
7.	Illinois	57	18.	Northwestern	25
8.	Michigan	55	19.	Purdue	25
9.	Ohio	54	20	Texas	25
10.	Iowa	49			
11.	Pennsylvania State	48			

A comparison of Table 2 with Table 2 in last year's SCIENCE is interesting. Chicago has taken a big drop from 114 science dissertations to only 58. Minnesota, Cornell, Pennsylvania State and Texas gave more science doctorates in 1943 than in 1942. Every other institution gave fewer. When the 1943 totals are added to the nine-year totals given in last year's SCIENCE, the standings are:

1.	Cornell	886
2.	Wisconsin	879
3.	Chicago	857
4.	Columbia	755
5.	Illinois	741
6.	Michigan	740
7.	California	723

There are no significant changes of order below the seventh place.

One fact of some interest is that in 1943 forty-three dissertations were reported as "Secret war research." Of these, twenty-two were in chemistry, sixteen in physics, two in psychology and one each in pharmacology, physiology and zoology.

This report makes it clear that the war emergency is seriously reducing the output of doctorates in American universities. Perhaps this is as it should be. However, it is a situation that will demand early attention when the emergency is over because most of our technical and industrial advance ultimately depends upon scientific research in our universities. We are, of course, quite aware that many industries have their own research laboratories, but these depend for manpower upon the output of doctors from the universities.

EDWARD A. HENRY

UNIVERSITY OF CINCINNATI

SPECIAL ARTICLES

A FILTERABLE VIRUS ISOLATED FROM A CASE OF KAPOSI'S VARICELLIFORM ERUPTION

KAPOSI'S varicelliform eruption is a comparatively rare exanthem occurring in patients with atopic eczema. The condition is characterized by high fever for from 4 to 7 days, by leucopenia and by the presence of umbilicated vesicles, some of which may become pustular, involving only the eczematous portions of the skin. The disease is self-limited, and the prognosis is good.

A filterable[1] virus was isolated from the skin lesions of a 15-month-old child showing a clinical picture typical of Kaposi's varicelliform eruption. Fluid removed from cutaneous vesicles was inoculated on the

[1] Berkefeld fine, V–13.

cornea of a rabbit. Within 3 days lesions were noted. On the fourth day the rabbit cornea was removed, carefully washed in sterile saline and triturated in tryptose-phosphate broth in an agate mortar. After centrifugation, the supernatant fluid was Seitz-filtered and inoculated into mice intracerebrally and onto the retracted chorioallantois of embryonated hen's eggs. Blood agar cultures of the inoculum, aerobic and microaerophilic, were sterile. In 2 to 4 days the mice so inoculated developed convulsions and died. By the fourth day numerous small, opaque, pock-like lesions were observed on the chorioallantoic membranes. The strain has been perpetuated readily by egg and mouse passage. Other samples of vesicular fluid inoculated directly onto the retracted chorioallantoic membrane produced small pock-like lesions in 4 to 5 days. There was no evidence of bacterial infection, and all cultures were consistently negative. The egg strain has been maintained in serial passage on the chorioallantois (6 passages), and transfer from these eggs to mice and to rabbit's cornea gave results identical with the foregoing.

These two strains of virus, one isolated primarily by means of the rabbit's cornea and the other isolated primarily on the chorioallantois, gave similar results in all studies. Both strains have been well established in mice: the egg strain transferred to mice and carried at the present writing for 6 passages, the rabbit strain transferred to mice and carried for 7 passages. Thus far, it has been established by repeated tests that the virus when injected intracerebrally into mice produces convulsions and death in from 2 to 7 days in dilutions of 10^{-1} through 10^{-6}. Detailed titration studies are in progress, but as yet the minimal lethal dose has not been determined definitely. Mouse protection tests using sera of the patient demonstrate increasing titre of antibody to this infectious agent. Serum taken at 15 days and at 30 days after onset of illness showed high protective titre.

Dilutions of Virus	Patient's Serum I 7 days after onset	Patient's Serum III 15 days after onset	Patient's Serum IV 17 days after onset	Patient's Serum V 30 days after onset	Control Broth	Normal Human Serum
10^{-2}	4 4 5 7	□ □ □ □	T 10 □ □	T □ □ □	3 3 3 3	4 4 4 5
10^{-3}	7 7 7 7	□ □ □ □	□ □ □ □	□ □ □ □	4 4 4 4	5 5 5 5
10^{-4}	6 7 □ □	□ □ □ □	□ □ □ □	T □ □ □	4 4 5 5	7 7 7 8
10^{-5}	□ □ □ □	□ □ □ □	□ □ □ □	□ □ □ □	5 5 6 7	8 8 8 8

□ = Survived

T = Died trauma

○ = Died in convulsions, figure within circle indicating day of death

FIG. 1. Mouse Protection Test. Serum-Virus Mixtures Incubated at 37° C. for 2 Hours. Inoculation, 0.03 ml. IC.

The lesions on the chorioallantoic membrane are

small, opaque, whitish pocks which are discrete and can be seen with the unaided eye. Microscopic section reveals the presence of cellular proliferation in the ectodermal layer of the chorioallantois, of marked cellular proliferation in the mesoderm with considerable cellular infiltration, and a slight proliferation of the endodermal layer. Section of rabbit's cornea also shows considerable epithelial cell proliferation. In the mouse brain an encephalitic process is noted. Detailed histological studies are under way, and experimental work is in progress with a view to establishing the identity of the virus.

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VARIABILITY OF THEILER'S VIRUS OF MOUSE ENCEPHALOMYELITIS[1]

ONE of the accepted characteristics of Theiler's virus[2] in albino mice is the high potency of the infectious agent—as demonstrated by intracerebral injection—and its limited infectivity—as determined by intraperitoneal inoculation In other words, while the virus will abundantly multiply when sowed directly upon susceptible nerve tissue, it evidently has but little ability to reach the same tissue from peripheral channels of infection. The reasons for this discrepancy are not clear. For instance, the virus could be restrained in peripheral invasion by whatever individual protection the immune mouse may interpose; however, the response of Theiler-free cotton rats to intraperitoneal injection does not differ from that of Theiler-carrying albino mice. We are therefore dealing with an intrinsic property of the viral agent itself, probably brought about by prolonged interaction between virus and herd immunity within its natural host.

When Theiler's virus (GDVII strain) is serially passed through cotton rats, the virus will, on certain occasions, mutate and exhibit new biological properties.[3] For instance, cotton rat variants thus produced possess marked peripheral invasiveness for both cotton rats and albino mice; they may also prove capable of paralyzing other hosts, normally refractory to infection with Theiler's mouse virus, such as guinea pigs and rhesus monkeys. Data have recently been collected which show that similar changes can occur spontaneously during rapid mouse-passages of Theiler's virus (GDVII strain), especially following *in vitro* contact with certain normal sera. It is the object of this communication to briefly report these observations.

It has been our practice to maintain the virus in albino mice by serial intracerebral passage, transfers being usually separated by intervals of from two to four weeks. Occasional titrations over a period of almost two years indicated some fluctuation in potency, but, in general, the virus preserved its high intracerebral titer (10^{-6} to 10^{-8}) without gaining appreciably in virulence by intraperitoneal inoculation (10^{-1}). Irregularities were first observed when virus was harvested from mice—serving as controls in neutralization tests—which had become paralyzed following intraperitoneal injection with mixtures of virus and certain normal sera (rabbit, horse, guinea pig, man). The brains of such mice, on subsequent titration, often contained virus capable of paralyzing albino mice, intracerebrally as well as intraperitoneally, in extremely high dilutions It was not immediately clear whether the observed phenomenon had occurred: (1) as the result of previous contact between virus and serum, (2) because virus was used which had been collected from intraperitoneally injected mice, or, (3) whether the rapid transfer of virus attending these operations, irrespective of derivation, had served to increase its virulence. Investigation of the three possibilities led to the following results: Ten experiments were carried out in which virus was exposed to contact with normal serum by means of intraperitoneal injection of virus-serum mixtures; in seven instances virus obtained from the brains of paralyzed mice reached intraperitoneal titers between 10^{-3} and 10^{-10}. Four experiments were run in which contact between virus and serum was established by intracerebral injection of virus-serum mixtures; in two instances titration of the resulting virus brains revealed intraperitoneal titers between 10^{-3} and 10^{-8}. Four experiments were finally conducted in which virus was passed rapidly, without serum contact, by either intracerebral or intraperitoneal injection. These last experiments were synchronous with an equal number of experiments in which virus was being transferred in combination with serum, the same batch of virus serving as source for both series. In one instance the virus showed unmistakable evidence of an increase in intraperitoneal titer (10^{-9}).

The use of the different methods mentioned yielded a total of ten viral substrains, all of which possessed high intraperitoneal potency for albino mice. When passed over three to five subsequent mouse-passages

[1] Aided by grants from the Dr. Philip Hanson Hiss, Jr., Memorial Fund, the Warner Institute for Therapeutic Research and anonymous donors.

[2] M. Theiler, SCIENCE, 80: 122, 1934; M. Theiler and S. Gard, *Jour. Exp. Med.*, 72: 49, 1940.

[3] C. W. Jungeblut, *Am. Jour. Publ. Health*, 33: 1227, 1943.

without serum, none of these strains suffered any loss of their enhanced peripheral titer. Furthermore, protracted contact of such virus with sub-effective doses of an antiserum prepared by immunization of rabbits against one of the invasive strains failed to bring about a reversion to non-invasiveness. From what has been said it is obvious that the described variation is clear-cut and permanent when it takes place; however, the occurrence of failures on repetition under identical experimental conditions attests to the unpredictable nature of the biological process involved.

Serological tests were performed in order to determine the identity of one of the new viral forms produced by contact with normal rabbit serum. As may be seen from Table 1, the non-invasive standard

TABLE 1

CROSS NEUTRALIZATION OF NON-INVASIVE AND INVASIVE STRAINS OF THEILER'S VIRUS BY CORRESPONDING ANTIVIRAL IMMUNE RABBIT SERA IN INTRACEREBRAL AND INTRAPERITONEAL TESTS

Theiler's virus		Antiserum against non invasive strain		Antiserum against invasive strain	
		Minimum lethal doses neutralized		Minimum lethal doses neutralized	
Phase	Potency	Intracerebrally	Intraperitoneally	Intracerebrally	Intraperitoneally
Non-invasive parent virus	1 c 10^{-7} 1 p 10^{-1}	10^{1}	10^{4}*	10^{3}	10^{4}*
Invasive variant virus	1 c 10^{-10} 1 p 10^{-9}	10^{4}	10^{10}†	10^{4}	10^{10}†

* Serum neutralized up to 1 1000 dilution.
† Serum neutralized up to 1 . 10 dilution

GDVII strain was neutralized quantitatively as well by its homologus antiserum as by a hyperimmune serum produced against the invasive strain. Conversely, neutralization of the invasive strain by its homologous antiserum occurred at the same levels as that obtained with anti-GDVII serum. Neither strain of Theiler's virus, invasive or non invasive, was neutralized when tested intraperitoneally with antisera produced against two strains of mouse-adapted human poliomyelitis virus (SK, MM).[4,5] It is clear from these data that the invasive variant of Theiler's virus was serologically indistinguishable from the non-invasive parent strain. It is also obvious that the invasive Theiler strain did not result from chance contamination with murine SK or MM virus.

In summary it may be said that rapid passage in mice of Theiler's virus of mouse encephalomyelitis induces, on certain occasions, a variation of the infectious agent. The most characteristic feature of this variation is an enhancement in the power of the virus to invade the central nervous system from peripheral channels of infection. The phenomenon apparently is aided by previous contact of virus with certain normal sera. The resulting variant seems to be stable since it retains its newly acquired properties over several mouse-passages. The available serological evidence indicates that the invasive strain is antigenically identical with the non-invasive present strain The reported data support earlier observations on biological changes of Theiler's virus and throw new light on the inherent variability of the viruses belonging to the poliomyelitis group.

Grateful acknowledgment is made of the assistance of Mr. Frank Vasi in the course of this work.

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[4] C. W. Jungeblut, M. Sanders and R. Feiner, *Jour. Exp. Med.*, 75: 611, 1942.

[5] C. W. Jungeblut and G. Dalldorf, *Am. Jour. Publ. Health*, 33: 169, 1943; C. W. Jungeblut, *Am. Jour. Publ. Health*, 34: 259, 1944.

FRUCTOSAN, A RESERVE CARBOHYDRATE IN GUAYULE, PARTHENIUM ARGENTATUM GRAY

IN the course of investigations on the carbohydrate metabolism of the rubber-producing plant guayule, indirect evidence was obtained for the presence of a polysaccharide having the properties of a fructosan. This constituent was isolated and identified as follows:

Two hundred grams of dry coarsely ground mixed guayule tissue was extracted with 80 per cent. ethanol until the percolate was colorless. The tissue was air dried, and extracted with 5 separate 300 ml portions of water at the temperature of the boiling water bath. The combined dark-colored water extract was then treated with excess neutral lead acetate, centrifuged, and deleaded with H_2S. After adjustment to pH 6, the solution was decolorized with charcoal at about 80° C and concentrated to 100 ml under reduced pressure.

Addition of 3 volumes of acetone to the concentrate caused the formation of a white precipitate, which was allowed to flocculate in an ice bath. This precipitate was centrifuged down, taken up in water at 80° C, treated with charcoal, and again precipitated with acetone in the cold. The resultant floc was taken up in water, treated with lead acetate, deleaded, and precipitated with acetone. After washing with acetone, the substance (I) was dried under vacuum.

The substance (I) was practically insoluble in water at room temperature, but dissolved readily in hot water to give a clear solution. It showed no color change with iodine, and was non-reducing. On mild acid hydrolysis the substance (I) gave rise to a

strongly reducing substance, II. Both I and II showed positive ketose tests with Seliwanoff's reagent, and were levorotatory. The osazone of II was identical with that of fructose.

On the basis of the above observations it is concluded that fructosan is one of the carbohydrate constituents of guayule. In so far as tests conducted to date indicate, this polysaccharide (I) appears to be inulin,[1] but its exact constitution remains to be determined.

Using a colorimetric method, values for the fructosan content in the stem and roots of guayule have ranged from 0.2 to 12 per cent. (dry weight basis), depending on the conditions under which the plants were grown. Evidence that this polysaccharide is the chief storage carbohydrate in this species will be presented in detail elsewhere.

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[1] After this note was submitted for publication, an incidental statement (not supported by data) to the effect that inulin occurs in guayule was found in a report of the Experimental Chemical Laboratory of the Italian Ministry of War (Silvio Guglielminetti, *Azzurra Agricola-Floreale*, 16: 63, 1936).

SCIENTIFIC APPARATUS AND LABORATORY METHODS

NUCLEAR BEHAVIOR IN RELATION TO CULTURE METHODS FOR PENICILLIUM NOTATUM WESTLING

DIFFERENCES in the yield of penicillin from *Penicillium notatum* Westling occur among strains or in subcultures of the same strain, even when grown from single spore isolations. Clutterbuck, Lovell and Raistrick[1] reported difficulty in maintaining Fleming's strain of *P. notatum*. Currently Hansen and Snyder[2] attribute this variation to the dual phenomenon which they have found to be characteristic of many fungi.[3] To maintain an active culture these authors recommend selection of a suitable strain following single spore isolation and tests for yield. Subsequent transfers can then be made by mass spore transfer.

Foster *et al.*[4] recommend merely the selection of a high potency strain and its maintenance by mass spore transfers. An analysis of the 19 substrains they derived from 3 different parent colonies clearly suggests that association and dissociation of genetic factors can not be overlooked as an explanation of the varied results recorded by these and other investigators

In none of these accounts has the nuclear behavior been taken into consideration. If heterokaryosis or the interaction of genetically different haploid nuclei in the same mycelium is responsible for the variation in penicillin production it is necessary to know whether *P. notatum* has a nuclear cycle capable of such behavior. The details of a cytological investigation of this fungus are now in press, to be published shortly.[5] It will suffice here to say that the conidia of this fungus are predominantly uninucleate although occasionally binucleate conidia occur. Using C and M to designate types, single conidia then could comprise either of these genetic factors or their possible combinations: C, M, CM, CC or MM, depending on the number of nuclei per conidium. If a spore is heterotypic then the genetic means of variation are present from the outset. If it is homotypic presumably the line can be developed monotypically provided no mutations occur. However, in mass spore transfers a few hours after germination there is marked anastomosis among the developing germ tubes, conidia and mycelia, giving abundant opportunity for nuclear interchange. Since analysis of cultural isolates indicates that the variations are due to a mixture of genetic factors following anastomosis and the establishment of heterokaryosis, it would appear that at present mass spore transfer methods would offer as certain a way as any of keeping active cultures. Unless a spore is binucleate and heterotypic, an infrequent condition in this fungus, the effect of heterokaryosis is eliminated by single spore transfer. Mass spore transfer increases the chances of nuclear mixing and consequently heterokaryotic vigor.

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HISTORY AND ACTIVITIES OF THE U.S.S.R. ACADEMY OF SCIENCES DURING THE PAST TWENTY-FIVE YEARS

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THE Library of Congress has appropriately taken steps to recognize the heroic efforts of the Russian people, who are making a stand to safeguard their borders and their civilization. This effort is being made according to the most logical and modern concept of defense and progress, namely, through concerted scientific, technical and cultural development. The past twenty-five years has taken on the aspect of a new "Renaissance" of Russian culture.

At the Library of Congress there has been installed an exhibition portraying this new "Renaissance." The exhibition centers principally about the history and work of the U.S.S.R. Academy of Sciences. The Academia Imperiale des sciences de Saint-Pétersbourg, Imperatorskaya Akademiya naük, was projected in 1718 by Peter the Great in cooperation and with the advice of German scholars of that period, principally Gottfried Wilhelm Leibnitz and Baron Chretien Wolff. Peter died in 1725 and his widow, Catherine I, ordered the opening of the academy according to prepared plans. The first meeting was held on December 27, 1725, with Laurent Blumentrost (1692–1764) as the first president, and with a large and distinguished group of foreign scholars in attendance. Catherine furthered Peter's plan by appointing a faculty of mostly German-Swiss scholars to the university, which was at the same time the academy. Included in the large number of scholars appointed and associated with the academy were Jacques Hermann, 1678–1733, professor of mathematics from Switzerland; Chretien Goldbach, 1690–1764, professor of mathematics from Germany; Leonard Euler, 1707–1783, professor of mathematics from Switzerland; Nicolas Bernoulli, 1695–1726, professor of mathe-

matics from Switzerland; Daniel Bernoulli, 1700–1782, professor of mathematics from Germany . . . and many others. Under the guidance of this notable group of scientists, the first of a long series of publications entitled "Commentarii Academiae Imperialis Scientiarum Petropolitanae" was issued by the academy.

In 1747 the academy was officially divided into two sections—the academy proper and the university. The latter, however, for lack of students, ceased to function by 1754 The University of Moscow opened in 1755, and so great was the intellectual growth among the Russian people that other cities soon established universities.

During the short reign of Peter II, the academy was neglected by the Court and the stipends of its members were discontinued; but it was again patronized by Empress Anne, who added a seminar under the superintendency of the professors. Both institutions flourished for some time under the direction of Baron Johann Albrecht Korff (1697–1766). At the accession of Elizabeth, the original plan was enlarged and improved, and again foreign scholars were drawn to St. Petersburg (Leningrad). It was considered a good omen for the culture of Russia when two natives, M. V. Lomonosov (1711–1765) and S. I. Rumovskii (1732–1812), who were men of genius and had prosecuted their studies in foreign universities, were enrolled among its members. Further stimulation was provided by Catherine II, who utilized the academy for the advancement of national culture. By her recommendation the most able professors visited all the provinces of her vast dominion, with ample means for research and publication in the natural resources of the country. The result was that no country at that time could boast within so few years such a number of excellent official publications concerning the natural sciences, together with the geography and history and other cultural interests of the different provinces. All these publications were issued by the academy. The first transactions, "Commentarii Academiae Scientiarum Imperialis Petropolitanae ad annum 1726," with a dedication to Peter II, were published in 1728. This was continued until 1747, when the transactions were called "Novi Commentarii Academiae," etc.; and in 1777, "Acta Academiae Scientiarum Imperialis Petropolitanae," with some alteration in the arrangements and plan of the work. The papers, hitherto in Latin only, were now written indifferently in Latin or in French, and a preface added, "Partie Historique," which contains an account of the society's meetings. Of the Commentaries, fourteen volumes were published: of the "New Commentaries" (1750–1776) twenty. Of the "Acta Academiae" two volumes are printed every year. In 1872 there was published at St. Petersburg in two volumes, "Tableau général des matières contenues dans les publications de l'Académie Impériale des Sciences de St. Petersbourg."

This latter publication contains an excellent historical résumé of the academy's early work, membership and lists of the various transactions and proceedings published since the founding date.

The buildings of the academy were furnished with the latest apparatus and the finest selection of books for the library, together with a museum and lecture halls. Quoting Alexander Petrunkevitch, of Yale University:

> However, such was the status of scientific progress with the special group created by the Tsars in the early eighteenth century. During the nineteenth century, education for the people in general, especially in the field of science, was for a long period unpopular and was limited to a comparatively small group. Even during the early period of this century education had not yet penetrated into the larger masses. The purely clerical knowledge of the Tsarist Russia gave way to military training and to such education as was necessary for service in the bureaucratic institutions created by Peter the Great. Later, humanistic studies became the standard of good education and dominated Russian society and Russian thought until comparatively recently. Medicine, of course, was early recognized as necessary knowledge, yet the people regarded it in the light of special knowledge, somewhat detrimental to broad education. Applied science, such as engineering, was for a long time looked upon in the same way, with the additional stigma of mistrust. Pure science was considered rather as a hobby for men with sufficient means, dangerous in so far as it inclined to produce a critical attitude toward religion and the established order of things, undesirable inasmuch as it did not open any other field for activity than an academic career, and insufficient as a general basis for broad education. In the second half of the past century pure science came into its own, conquered the opposition of society.

Yet the fact remains, Russia has in spite of these limitations produced a galaxy of scientists and scholars in the history of science comparable to those in any country. A brief list of these great leaders will convince one that in the face of opposition success can be attained. In the words of Lessing, the great German philosopher, opposition makes for strength. Nikolai I. Lobatschewskii [1793–1856] in mathematics, particularly in non-Euclidean geometry; Dmitri I. Mendeléev, [1834–1907] in chemistry, particularly the periodic tables of the chemical elements; Ivan P. Pavlov [1849–1936] in physiology, the study of brain functions; F. G. Wilhelm Struve [1793–1864] and Otto Wilhelm Struve [1819–1905] in astronomy, parallax and double star studies—these names and many others will live in the memory of man; but

ticularly in the great tradition of Russian scientific achievement. This is demonstrated again not alone in the names that have just been given, but by the leaders that are dominating the U.S.S.R. progress in science to-day. These leaders are not alone contributing to the war but to peace as well, and thus rendering a notable service to their country.

During the World War I or the Revolution of 1918, the Government of Russia was transferred from Leningrad to Moscow, but it was not until 1934 that the Academy of Science was also transferred. The forward-looking Russian scholars had planned a much larger and more modern structure built upon classical Greek motif; the World War II has delayed this program also. However, to-day the academy consists of approximately 136 academicians, more than 30 honorary academicians, about 224 corresponding members and over 5,000 scientific and technical assistants. Sixteen American scientists are now honorary or corresponding members of the academy. The portraits of some of the more prominent academicians have been included in the library's exhibition through the cooperation of the Embassy of the U.S.S.R. in Washington. Representative volumes of the more important works by members of the academy have been selected for display from the extensive collection of Russian materials in the Library of Congress, probably the richest to be found in any library in the Western Hemisphere.

The organization of the academy groups its activities in eight departments, to each of which a section of the library's exhibit is devoted: the departments of physico-mathematical, chemical, geology-geographical, biological and technical sciences, history, and philosophy, economy and law, and language and literature. Under these eight departments, the academy maintains 76 institutions, 11 laboratories, 47 stations, 6 observatories and 24 museums. There are also eight branches of the Academy of Sciences throughout the Soviet Union, under the supervision of which are 39 institutes, 28 stations, 3 astronomical observatories, 8 botanical gardens, 3 sanctuaries and 17 other scientific research establishments. The exhibit includes publications issued by each of the departments of the academy and some of its branches.

The peacetime work of the academy was suddenly interrupted on June 22, 1941, when Germany invaded Russia. From the very beginning of the invasion, the Academy of Sciences readjusted its activities to place its resources fully behind the Russian war effort. Even while Moscow was under heavy German attack, the institution continued the publication of its learned journals and texts. Books printed while the city was under Nazi bombardment are among those shown in the library's display.

Under the academy's direction, chemists have pioneered in manufacturing synthetic rubber, in photochemistry, in developing winter lubrications for tanks and planes, in producing new explosives and in extending the uses of helium. Soviet geologists have turned their energies to the problem of supplementing the stock of raw materials required by the Russian war machine, and agronomists have increased the productivity of agriculture. Physiologists and physicians of the U.S.S.R. have won international fame for their treatment of shock, tetanus, gangrene and other war maladies, and dieticians have found new nutritive substances, as well as new sources of vitamins, which have been used to help solve the food problems resulting from the war. Technologists have also scored notable successes in finding substitutes for scarce materials, in simplifying technological processes and perfecting the organization of war industries. Most of these activities are represented in one way or another by publications on display.

Exhibited items of particular interest include the first volume of transactions published by the academy, the "Commentarii academiae scientiarum imperialis petropolitanae," published in 1728 at St. Petersburg; pictures of the first building of the academy in Leningrad, its present home in Moscow to which it moved in 1934, and the architect's drawing of its proposed new building; numerous publications of various scientific establishments attached to the General Assembly, and current periodicals concerning the academy as a whole. It is interesting to note that, while the publications of the academy are published mainly in Russian, a number have been published in English as well, while others have titles and summaries in English. M. V. Lomonosov, whose portrait appears in the historical section of the exhibit, is described as "probably the most interesting figure in the whole existence of the academy."

The academy's usefulness and influence under conditions never before experienced by man are indeed most remarkable in the annals of the history of science. The administration and various functions of the Soviet Academy are directed by the following well-known scientists and scholars: Vladimir Komarov, botanist, is president of the Academy of Sciences of the U.S.S.R. since 1936. Abram Joffe, vice-president of the Academy of Sciences and director of the Leningrad Physico-Technical Institute, is known for his researches in the field of electron semi-conductors. Alexander Baikov, first vice-president of the Academy of Sciences, is an expert on astringents, metallurgy and metallography. Peter Kapitsa, physicist, is director of the Institute of Physical Problems of the Academy of Sciences. From 1921–35 Kapitsa worked in Lord Rutherford's laboratory in Cambridge. Sergei

Vavilov, physicist, is director of the Lebedev Physics Institute of the Academy of Sciences and chief of scientific research work of the State Institute of Optics. Ivan Vinogradov, outstanding Russian mathematician, is known for his new theory of numbers and his solution of the famous Goldbach problem. He is a member of the Royal Society of London and honorary member of the London and other mathematical societies. Leon Orbeli, vice-president of the Academy of Sciences, is head of the Institute of Higher Nervous Activity and of the Biological Station in Pavlovo. Trofim Lysenko is president of the All-Union Lenin Academy of Agricultural Sciences and vice-chairman of the Supreme Soviet of the U.S.S.R. Dmitri Prianishnikov, founder of Russia agro-chemistry, has published more than 360 papers and written text-books on agro-chemistry and agriculture. Alexei Favorskii is well known in the field of organic chemistry, in which he created a new branch . . . the chemistry of acetylene and its derivatives. Vladimir Obruchev, Russian geologist and geographer, author of 300 works, among the most important of which are "Ore Deposits" and "The History of Geological Research in Siberia." Eugene Tarle, historian, is the author of many volumes on the history of the West and of Russia, including "Invasion of Russia by Napoleon in 1812," "The Working Class of France During the Revolutionary Epoch." Viacheslav Volgin, vice-president of the Academy of Sciences, is a historian-sociologist. Nikolai Derzhavin, member of the Presidium of the Academy of Sciences, is a philologist, scholar of the Slav languages and of the history of literature. Alexei Tolstoi, member of the Academy of Sciences, is one of the foremost Soviet authors. His works include the long novel "Peter the Great."

One of the most interesting and historically significant facts bearing upon the new "Renaissance" of Russia is the ability of her people during her most trying period to advance nationally through the progress of science. Shortly before and during this present conflict, the Russian scholars have selected the historical medium for advancement by paying gracious tribute to England and the English-speaking world by acknowledging the work of the greatest figure in the history of physical science, namely, that of Sir Isaac Newton.

Under Peter the Great, there was some development in practical mathematics, but with the imported scholars, particularly after the founding of the Academy of Sciences in 1725, pure mathematics made some progress. Interest in astronomy, physics and biological sciences followed in rapid order.

In the academy's various publications, such as the Commentarii, Novi Commentarii, Acta, Nova Acta and Mémoires de l'Académie Impériale des Sciences, the contributions became more sound in scholarly importance and practical interpretation. We note that the works of Daniel and Jean Bernouilli, Leonard Euler and others in celestial mechanics and mathematical physics were most prominent. However, the influence of Newtonian philosophy made no great progress in Russia at this time. In contemporary France and Germany, Newton was rapidly accepted. The cause of this neglect of Newton in the vigorous new life of Russian interest in mathematical science is not apparent. It was not until two centuries later that formal recognition of Newton became evident. In 1927, Newton's "Optics" ("Optika ili traktat . . . sveta," S. I. Vavilov) was translated into the Russian language. In 1931, at the International Congress of the History of Science and Technology, held in London, the delegates of the U.S.S.R. presented a series of addresses in which it was shown that Newton's philosophy appeared to have influenced social consciousness, through the Marxian doctrine of social change and methods of production. That is, "the method of production of material existence conditions the social, political and intellectual process of the life of society."

Further expression of appreciation of Newton's works and influence on scientific thought is indicated by a translation in 1936 into Russian of the "Principia," first edition, namely: "Matematicheskie nachala natural'noi filosofii. Perevod s latinskogo," A. N. Krylova. This was followed by another translation of Newton's principal work in pure mathematics: "Matematicheskie raboty. Perevod s latinskogo," D. D. Mordukhai-Boltovskogo. In 1943 two publications were produced: one an interesting Russian interpretation of Newton's life, namely, "Isaak N'iuton," by S. I. Vavilov; and the other a volume containing eighteen papers given at a symposium in commemoration of the tercentenary of Newton's birth. These addresses were given by the leading scholars and scientists of Russia, more or less familiar to the American public.

The Embassy of the U.S.S.R. has just announced through its bulletin of information dated May 6, 1944, that fifteen Isaac Newton Scholarships for students in the mathematics and physics department of Soviet higher educational institutes were recently established by the People's Commissariat of Education. Three of the scholarships have been awarded to students of Moscow University. The Scientific Council of the University selected two girl students of mathematics and a student of physics as the most deserving candidates for the scholarships.

As a further expression of cordiality between the Soviet government and the British government, there took place in Moscow on January 6, 1944, an inter-

esting ceremony. This manifestation was in the form of a beautiful and specially bound copy of Newton's "Principia," presented by the Royal Society of London to the Academy of Sciences of the U.S.S.R. Accompanying this volume there was an original draft of a letter by Newton to Prince Alexander Menshikov, acquainting the latter with his election into the fellowship of the Royal Society in 1714. The prince was the first Russian to be elected to the Royal Society.

OBITUARY

CHARLES BENEDICT DAVENPORT

CHARLES BENEDICT DAVENPORT was born in Stamford, Conn., on June 1, 1866, and died on February 18, 1944, at the age of 77. He was tutored by his father, a former teacher, until he was fourteen years old. At that age he entered the Brooklyn Polytechnic Institute, where he received the B.S. degree in 1886. During the following year he was a member of the engineering corps engaged in surveying the Duluth, South Shore and Atlantic Railroad. He entered Harvard in 1887, received an A.B. in 1889 and a Ph.D. in 1892. At Harvard he served as assistant in zoology from 1887 to 1893 and as instructor from 1893 to 1899. In the latter year he became assistant professor of zoology at the University of Chicago and was associate professor there from 1901 to 1904. He was director of the Biological Laboratory at Cold Spring Harbor from 1898 to 1923. In 1904 Dr. Davenport was appointed director of the newly established Department of Experimental Evolution, Carnegie Institution of Washington, at Cold Spring Harbor, Long Island, N. Y. This post he held for thirty years, till his retirement in 1934.

Dr. Davenport early became one of the world's leaders in the new science of genetics. In three different ways he made important contributions to science: by investigation of biological phenomena, more particularly of the laws of heredity in domestic animals and man; by the organization of facilities for research upon animal, plant and human heredity; and by the publication of many books and monographs on heredity, anthropology and statistical methods in biology. In the earlier part of his career he gave particular attention to experimental morphology, to the statistics of variability, to the role of water in the growth of organisms, to the acclimatization of organisms to poison and heat, and to kindred questions regarding the lower animals. Later, however, his studies were conducted wholly on higher vertebrates and man. In 1910, at Cold Spring Harbor, he organized the Eugenics Record Office, a clearing house for data on inheritable traits of American families and for giving advice to individuals on marriage and to states on defective communities. The facilities of the Record Office led to the discovery of the method of heredity of epilepsy in man, how it is produced and how in later generations it may be prevented; also, to the method of inheritance of eye color, hair color, skin pigmentation and other characteristics in man. These studies were preceded by his purely experimental studies conducted on poultry, sheep and canaries. His studies on a very wide variety of animal and human materials notably increased our knowledge of the role of the genes in animal and human development.

During two to four decades Dr. Davenport served as editor or associate editor of several journals devoted to zoology, genetics, eugenics and anthropology. Among his published books the following are notable: "Experimental Morphology," Parts 1 and 2; "Statistical Methods in Biological Variation"; "Introduction to Zoology" (with Gertrude C. Davenport); "Inheritance in Poultry"; "Inheritance in Canaries"; "Inheritance of Characteristics in Domestic Fowl"; "Eugenics, the Science of Human Improvement by Better Breeding"; "Heredity in Relation to Eugenics"; "Heredity of Skin-Color in Negro-White Crosses"; "The Feebly Inhibited, Nomadism and Temperament"; "Naval Officers, Their Heredity and Development" (with M. T. Scudder); "Physical Examination of the First Million Draft Recruits; Methods and Results" (with Colonel A. S. Love); "Defects Found in Drafted Men" (with Colonel Love); "Army Anthropology" (with Colonel Love); "Body Build and Its Inheritance"; "The Nam Family" (with A. H. Estabrook); "Race Crossing in Jamaica" (with M. Steggerda); "The Genetical Factor in Endemic Goiter"; "How We Came by Our Bodies."

This partial list of his books reflects both the broad interests and the phenomenal energy of the man. Few men have applied themselves more continuously or more ardently to research. Few men could successfully withstand, as he did, the physical stress to which he regularly subjected himself. His retirement as director of a research institution involved no slackening in the pursuit of his own investigations. For Dr. Davenport life was, above all, opportunity for insistent, driving inquiry.

Dr. Davenport was a member of numerous American and foreign scientific societies. In 1923 he received the gold medal of the National Institute of Social Sciences. During World War I, he served as a Major in the Office of the Surgeon General, U. S. Army. He was active in many civic enterprises, and in 1942 he helped establish the Cold Spring Harbor

Whaling Museum, of which he was a director and curator. Shortly before his death a whale was found on a Long Island beach; Dr. Davenport secured its head, and in the process of preparing the skull for exhibition and study he caught a cold which led to a fatal pneumonia.

Those who intimately knew Charles Davenport well know that he was never too busy to give encouragement, counsel and help to younger biologists who brought their problems to him. This large group of men and women, his neighbors, and his many associates in the institutions which he served so long will long remember the rare kindliness and modesty of the tireless man and scientist who daily strove to bring his tasks to a worthy end.

OSCAR RIDDLE

LEROY SHELDON PALMER
1887–1944

THE passing away on March 8 of Leroy Sheldon Palmer, chief of the division of agricultural biochemistry of the University of Minnesota, came as a great shock to his associates and many friends. Dr. Palmer was stricken almost immediately on reaching his office on February 25th and taken to the University Hospital, where death came to him 12 days later from a coronary occlusion.

Dr. Palmer, born at Rushville, Illinois, on March 23, 1887, was the son of Samuel C. and Annie Goodman Palmer and the twin brother of Robert C. Palmer, now a chemist and director of research in the Newport Company of Pensacola, Florida. After receiving his B.S. degree in chemical engineering from the University of Missouri in 1909 he became interested in dairy chemistry, and continuing his studies at that university acquired his M.S. degree in 1911 and his Ph.D. degree in 1913. He served on the teaching staff of the University of Missouri until 1919, during which time he formed a research partnership with the late Dr. C. H. Eckles which carried over into many fruitful years of dairy research at the University of Minnesota.

Dr. Palmer came to the University of Minnesota in 1919 as associate professor of dairy chemistry and soon became professor of dairy chemistry and animal nutrition. After the death of Dr. Ross Aiken Gortner in 1942 he was appointed chief of the division of agricultural biochemistry.

On coming to Minnesota, Dr. Palmer at once began his research in dairy chemistry which has dealt with the chemistry of milk and dairy products, their composition as affected by the nutrition of the animal, the physical and colloidal chemistry of milk, the chemistry of rennet coagulation, the churning process and many other theoretical phases of milk chemistry. At this same time he also planned extensive research with the late Dr. C. H. Eckles, of the division of dairy husbandry, in dairy cattle nutrition, especially mineral and vitamin nutrition of bovines. He was still cooperating in this research at the time of his passing. His nutrition studies were not confined to dairy cattle but extended into the broader field of animal nutrition in which research is conducted with the small laboratory animal. He was always more interested in the fundamental problems of nutrition than in those problems which could be quickly solved. Thus research which was conceived in the early twenties is still in progress.

Dr. Palmer's contributions to scientific journals number more than 166, and he had also written or made important contributions to seven books. However, his major contribution to science has been through his students, of whom 19 received the M.S. degree and 42 the Ph.D. degree at this university. The success attained by these students testifies to the truthfulness of this statement. He gave freely and liberally of his time and thought to the problems of his graduate students and was a teacher well loved and respected both by the older postgraduate and the younger undergraduate groups. He possessed not only the method and spirit of true graduate work but also a keen intellect and mature judgment, which made him an invaluable counselor. He was always critical in his examination of scientific research, but his criticism never carried a sting. He never failed to help with suggestion and advice and all those who were associated with him worked with a zest and happiness which could only be inspired by a truly great leader.

Dr. Palmer was selected in 1939 as the first recipient of the Borden Award for outstanding research in the chemistry of milk. The standards governing the presentation of the award are high. Only research of the most significant nature is deemed worthy of the award.

Dr. Palmer's scientific achievements won him membership in the leading scientific societies and honorary fraternities in the country. Besides his service on the staff of the *Journal of Dairy Science* as associate editor, he has acted in the capacity of counselor for the American Chemical Society and chairman of the Minnesota Section of this society, vice-president of the World's Dairy Congress (1923), president of the Minnesota Chapter of Sigma Xi, consultant to the American Medical Association and collaborator in the U. S. Pharmacopoeia Vitamin Standardization Committee (1937).

Dr. Palmer's life was not entirely given to study and research. He loved outdoor life and a round of golf; a day of fishing or a long drive through beautiful country gave him the keenest pleasure. He had a fine appreciation of music and literature and spent many quiet evenings in his home reading and listening to radio broadcasts by our great artists. He liked

people and took great pleasure in having his friends in his home, where he was always at his best as a kind and friendly host.

It is with heavy hearts that his associates in the division of agricultural biochemistry carry on the traditions of the department he helped to build.

CORNELIA KENNEDY

UNIVERSITY OF MINNESOTA

DEATHS AND MEMORIALS

DR. CONRAD ENGERUD THARALDSEN, professor of anatomy and director of the William Waldo Blackman department of anatomy of the New York Medical College, died on May 20 at the age of sixty years.

IN commemoration of the twentieth anniversary of the death of Dr. Ernest Fox Nichols, who was from 1892 to 1898 professor of physics at Colgate University, his portrait has been presented to the university by Mrs. Nichols.

ROLF SINGER, assistant curator of the Farlow Herbarium of Harvard University, writes: "We have just received word from friends in Leningrad that Professor Woldemar H. Tranzschel, the most famous mycologist of Russia and specialist of the highest international standing, died during the siege of Leningrad late in 1942. His work on rusts was of high theoretical importance and of immediate practical value for his native country. He was highly honored by the Academy of Sciences of the U. S. S. R., where he had worked during most of his lifetime. He was loved by his numerous pupils and collaborators. Two genera of fungi, *Tranzschelia* and *Tranzscheliella*, were named in his honor, and uredinists of all countries are familiar with his discovery of a relationship between the taxonomy and the ecology of certain types of rust, the so-called Tranzschel-rule. W. Tranzschel cultivated scientific exchange with American mycologists. He is one of the truly irreplaceable victims of total war."

AT a meeting of the council of the American Mathematical Society held on April 29, the death on January 10 of Professor Thomas Scott Fiske, of Columbia University, was announced and appropriate resolutions were adopted. In 1888 through the efforts of Professor Fiske, then a young man of twenty-three years, the New York Mathematical Society was established. Three years later the name was changed to American Mathematical Society. Professor Fiske held the following offices in the society: *Secretary*, 1888–1895; *Treasurer*, 1898–1901; *President*, 1903–1904. He was present at the semicentennial celebration meeting in 1938 of the society he had founded.

SCIENTIFIC EVENTS

THE HALL OF MEXICAN AND CENTRAL AMERICAN ARCHEOLOGY OF THE AMERICAN MUSEUM OF NATURAL HISTORY

THE American Museum of Natural History has recently reopened its Hall of Mexican and Central American Archeology after a complete revision and reinstallation of the exhibits. Although wartime restrictions prevented any extensive alterations in the architectural decor, it was possible to effect a vast improvement not only in the appearance of the exhibits, but in their educational value. The hall is approached through a foyer where a series of five miniature groups presents the ecological variety of Mexico and Central America and illustrates for the visitor the settings in which the prehistoric cultures of the region flourished. Also in this section, fine individual examples of prehistoric art in the form of gold ornaments, jade carvings and pottery are displayed in illuminated niches sunk into the wall.

The hall itself is arranged to serve two interests, that of the casual visitor who wants simply to get an overall picture of the extent and nature of the civilizations of Mexico and Central America and that of the student who wishes to study the collections in detail. For the former a series of illuminated cases containing representative examples of the prehistoric art is deployed on either side of the main axis of the hall. The visitor may, therefore, by walking through the hall gather a visual picture of the character of the native cultures as reflected in their stone work, their pottery and their figurines. Supplementing these exhibits are deep wall cases at either end of the hall, where the famous Stephens Collection of Maya Art and other fine collections are on display, lighted from within the cases.

Along the sides of the hall the analytical exhibits are on view in a number of alcoves. These were designed primarily for the students who frequent the exhibits and for those visitors whose deeper interest might be aroused by the central exhibits. In these cases the various local cultures are defined by typical specimens, their stylistic variations are clarified and their growth and development explained. The complete stratigraphic sequence for the Valley of Mexico is here for the first time placed on view.

Casts of large monuments, stelae and altar stones, architectural models and original stone sculptures are dispersed throughout the hall to supplement the case exhibits. This rearrangement, together with the use

of case lighting and the device of painting the walls and the cases in the same color, lends a greater visibility to the specimens than they previously enjoyed.

The Hall of Mexican and Central American Archeology is under the charge of the Department of Anthropology, of which Dr. Harry L. Shapiro is chairman. The revision of the exhibits was planned and executed by Dr. Gordon F. Ekholm, assistant curator, and Clarence L. Hay, research associate. They were assisted by Victor Ronfeldt, Miss Katharine Beneker, Joseph M. Guerry and Matthew Kalmenoff.

THE MUNSELL FOUNDATION TO PROMOTE COLOR STANDARDIZATION

It is reported in *Industrial Standardization* that the promotion of color standardization, nomenclature and specification is one of the primary objects of the Munsell Color Foundation, Inc., which was organized recently. The foundation will also encourage the application of scientific knowledge to color problems arising in science, art and industry.

The foundation is a non-profit organization, which will have a board of trustees, one of whom is to be a member of the staff of the National Bureau of Standards; one to be appointed by the executive committee of the Inter-Society Color Council; one by the manager of the Munsell Color Company; one to be the representative of the Munsell family, and three trustees at large.

Deane B. Judd is the first trustee of the new foundation to be appointed by the director of the National Bureau of Standards, and Loyd A. Jones, nominated by the Optical Society of America, is one of the trustees at large. Both Dr. Judd and Mr. Jones are active in technical committees working on American standards under the procedure of the American Standards Association.

The American War Standard on Specification and Description of Color, approved by the American Standards Association in 1942, recognizes the Munsell Book of Color as the only system of material color standards calibrated in terms of the basic specification—the percentage of light reflected or transmitted by the color, as determined by the spectrophotometer. The system of color names of the Inter-Society Color Council-National Bureau of Standards is also based on the Munsell system.

THE NORTH CAROLINA STATE COLLEGE CHAPTER OF THE SOCIETY OF THE SIGMA XI

The Sigma Xi Club at North Carolina State College has become the North Carolina State College Chapter of the Society of Sigma Xi. The installation took place on April 17 in the college Y. M. C. A. auditorium. The activities of the day began with a business meeting, with Dr. George A. Baitsell, executive secretary of the national chapter, presiding. The constitution for the new chapter was adopted, charter members signed the constitution and the following were elected officers: Dr. Ralph W. Cummings, head of the department of agronomy, *President;* Dr. G. Wallace Smith, head of the department of engineering mechanics, *Vice-president;* Dr. Samuel G. Lehman, professor of plant pathology, *Secretary;* Dr. William G. Van Note, associate professor of metallurgy, *Treasurer;* Professor L. L. Vaughn, dean of the Engineering School, and Dr. F. H. McCutcheon, professor of zoology, *Members of the Executive Committee.*

At the installation ceremony the petition for the new chapter was presented by Dr. F. H. McCutcheon, retiring president of the club. This was accepted on behalf of the national society by Dr. Baitsell, who reviewed the grounds for installation of the chapter and presented the charter. Dr. Ernest Carroll Faust, a member of the National Executive Committee, made the installation address, presenting the charge to the new chapter. Dr. Cummings accepted the charter and made the response for the petitioning group. Colonel John W. Harrelson, dean of administration, reviewed the advancements and achievements in research of the college and pledged the administration to increased support of research in the future.

Following the formal installation, a reception for members and delegates was held at the home of Colonel and Mrs. Harrelson. In the evening a dinner was served for the national officers, visiting delegates, chapter members and their wives. Following the dinner, Dr. Ernest Carroll Faust delivered an address entitled "Some Biological Interrelationships."

ELECTIONS OF THE NATIONAL ACADEMY OF SCIENCES

Elections at the spring meeting of the National Academy of Sciences held in Washington on April 25 are:

Treasurer: Dr. J. C. Hunsaker, Massachusetts Institute of Technology (for a further term of four years; ending June 30, 1948).

Members of the Council (for terms of three years ending June 30, 1947):

Ernest W. Goodpasture, Vanderbilt University.

Irving Langmuir, General Electric Company, Schenectady, New York.

New Foreign Associates:

Edward B. Bailey, Geological Survey, Exhibition Road, S. W. 7, London, England.

Leopold Ruzicka, Department of Organic Chemistry, Institute of Technology, Zurich, Switzerland.

New Members:

Thomas Addis, Stanford University Medical School, San Francisco.

Charles Armstrong, United States National Institute of Health, Washington, D. C.
Philip Bard, the Johns Hopkins University School of Medicine.
George Wells Beadle, Stanford University.
Hans A. Bethe, Cornell University.
Edward U. Condon, Westinghouse Research Laboratory, East Pittsburgh.
George O. Curme, Jr., Carbide and Carbon Chemicals Corporation, New York, N. Y.
Hugh L. Dryden, National Bureau of Standards, Washington, D. C.
Carl Owen Dunbar, Yale University.
Vincent du Vigneaud, Cornell University Medical College, New York, N. Y.
James Franck, University of Chicago.
Reynold C. Fuson, University of Illinois.
Edwin Bret Hart, University of Wisconsin.
Selig Hecht, Columbia University.
Alfred H. Joy, Mt. Wilson Observatory, Pasadena.
Esper Signius Larsen, Jr , Harvard University.
James B. Macelwane, St. Louis University.
Leonard A. Maynard, Cornell University.
Barbara McClintock, Department of Genetics, Carnegie Institution of Washington, Cold Spring Harbor.
C. R. Moore, University of Chicago.
Alfred S. Romer, Harvard University.
Louis B. Slichter, Massachusetts Institute of Technology.
Lee I. Smith, University of Minnesota.
Don M. Yost, California Institute of Technology.
Oscar Zariski, the Johns Hopkins University.

SCIENTIFIC NOTES AND NEWS

THE Remington Honor Medal for 1944 has been awarded by the New York Branch of the American Pharmaceutical Association to Dr. H. Evert Kendig, dean of the School of Pharmacy of Temple University. The medal is conferred each year for work carried out during the preceding year, or culminating over a period of years, that is judged to be the most important to American pharmacy.

THE Lamme Medal for "outstanding engineering achievement" for 1944 has been awarded by the Ohio State University to Henry M. Williams, of Dayton, Ohio, since 1938 vice-president of the National Cash Register Company in charge of engineering and research. The presentation will be made in June during the commencement of the university.

THE James Ewing Award of the Westchester County, N. Y., Medical Society, was presented on May 16 to Dr. Richard Charlton, for fifteen years chairman of the Westchester Cancer Committee of the American Society for the Control of Cancer.

IN connection with the presentation on April 14 of the Gold Medal of the Royal Astronomical Society to Dr. Otto Struve, as reported in *The Times*, London, Professor E. A. Milne, president of the society, called attention to the circumstance "that this was the fourth time an astronomical member of the Struve family had been awarded the gold medal of the society. It had been received four times in a hundred and eighteen years, or once in each generation."

AT the presentation on May 31 to Dr. George O. Curme, Jr., of the Willard Gibbs Medal of the Chicago Section of the American Chemical Society, Dr. L. M. Henderson, of the Pure Oil Company, chairman of the section, spoke on "The Willard Gibbs Medal," and J. G. Davidson, vice-president of the Carbide and Carbon Chemicals Corporation, discussed "The Medalist." Dr. Charles L. Parsons, of Washington, D. C., secretary of the American Chemical Society, made the presentation.

DR. E. A. MILNE, Rouse Ball professor of mathematics at the University of Oxford, has been elected president of the Royal Astronomical Society

DR. HOMER L. DODGE, professor of physics at the University of Oklahoma, dean of the Graduate School and director of the University of Oklahoma Research Institute, has been elected the eighteenth president of Norwich University, Northfield, Vt. Since 1942 Dr. Dodge has been on leave of absence to serve as director of the Office of Scientific Personnel of the National Research Council. He will assume his duties as president on August 1. Norwich University is a military college with basic curricula in liberal arts and engineering. The one hundred and twenty-fifth anniversary of its founding will be celebrated on August 6 with Colonel Herman Beukema, formerly director of the Army Specialized Training Program and now of the U. S. Military Academy at West Point, as the principal speaker.

DR. WILLIAM KING GREGORY, curator of the departments of comparative anatomy and fishes of the American Museum of Natural History, New York City, having reached the retirement age, has resigned as head of these departments. Dr. Gregory has been a member of the scientific staff of the museum since 1900. Dr. Charles M. Breder, who was appointed curator of fishes last December, will become chairman of the department.

DR. WILTON M. KROGMAN, associate professor of anatomy and physical anthropology at the University of Chicago, has been appointed research associate in physical anthropology of the Chicago Natural History Museum and Professor Hanford Tiffany, head of the

department of botany at Northwestern University, has been appointed research associate in cryptogamic botany.

DR. ALONZO QUINN, associate professor of geology at Brown University, has been elected vice-chairman of the Council on Mineral Industries of New York and the New England States.

DR. HERMAN C. MASON, associate professor of bacteriology and immunology at the College of Medicine of the University of North Carolina, has resigned to accept a position with the Schering Corporation of Montclair, N. J.

CLARENCE W. SONDERN, research director of George A. Breon and Company, has become director of laboratories at the White Laboratories, Inc., Newark, N. J.

ATHERTON LEE, from 1934 to 1941 director of the Experiment Station in Puerto Rico of the U. S Department of Agriculture, later chief of the National Rubber Division of the War Production Board, has become associated with the United Fruit Company.

BERNICE S. BRONNER, formerly head of the textile laboratory of the Good Housekeeping Institute, has joined the staff of the American Standards Association with the title of textile technologist.

DR. HAROLD J. ROSE, vice-president in charge of research of Anthracite Industries, Inc., New York, has resigned to assume a similar position with Bituminous Coal Research, Inc., at Pittsburgh. He will be in charge of a five-year program, on which it is planned to expend $2,000,000 for research and the development of coal production and utilization to meet wartime problems and to strengthen the postwar position.

PROFESSOR NELSON S. HIBSHMAN, head of the department of electrical engineering of New York University, has been appointed director of the School of Science and Technology of the Pratt Institute, Brooklyn, N. Y.

PROFESSOR SUMNER C. BROOKS and Dr. Matilda Moldenhauer Brooks, of the University of California at Berkeley, have returned to the United States from a six-months visit to South America. They lectured at various universities and academies of science in Lima, Peru, Buenos Aires, Montevideo and Rio de Janeiro under the auspices of the Cultural Relations Division of the Coordinator of Inter-American Affairs Committee. The subject of the lectures was "The Ultra-structure, Permeability and Accumulation of Salts in Living Cells" and "Oxidation-reductions in Living Cells."

BENJAMIN Y. MORRISON, of the Office of Foreign Agricultural Relations, is in Colombia, where he is assisting in the coordination of the agricultural research program, especially as it relates to the production of cinchona. He will collaborate with the proposed development corporation, the Caja de Crédito Agrario Industrial y Monero, and the Ministry of National Economy as a consultant on research related to agriculture wherever such work is carried on by the Colombian Government.

EDWARD L. TANNER, of the Office of Foreign Agricultural Relations, has been assigned to the Cooperative Experiment Station in Nicaragua to conduct agronomic work on coconuts, sesame and other oil-yielding plants, on rice and on abacá.

DR. ANATOL A. SMORODINTZEV, head of the department of virus diseases of the Institute of Experimental Medicine in Moscow, gave on May 26 the Cutter Lecture on Preventive Medicine at the Harvard Medical School. The lecture was entitled "New Forms of Encephalitis in the U.S.S.R." Dr. Smorodintzev is in America as a guest of the Rockefeller Foundation.

DR. WM. H. HOBBS, professor emeritus of geology of the University of Michigan, delivered on May 12 the annual address before the University of Cincinnati Chapter of Sigma Xi. It was entitled "The North American Glaciation in the Light of Studies of the Greenland Glacier." On May 14 he gave an illustrated lecture on "The Island Fortresses of the Pacific."

PROFESSOR MARSTON T. BOGERT, of the department of chemistry of Columbia University, gave on April 27 an address at Poughkeepsie before the Mid-Hudson Section of the American Chemical Society. The address was entitled "Malaria, Mankind's Public Enemy No. 1."

DR. LAURENCE H. SNYDER, chairman of the department of zoology and entomology of the Ohio State University, addressed on May 10 the combined chapters of Phi Beta Kappa, Sigma Xi and Phi Kappa Phi of the University of Utah. On May 11 he addressed the student body at Brigham Young University. "Medical Genetics" was the subject of both lectures.

DR. WALTER R. MILES, professor of psychology in the School of Medicine of Yale University, on May 1 presented an illustrated lecture on "Aviation Psychology" under the auspices of the newly installed chapter at Vanderbilt University of the Society of the Sigma Xi.

THE four hundred and third meeting of the American Mathematical Society was held at Columbia University on April 28 and 29. The attendance was about two hundred, including one hundred and sev-

enty-eight members of the society. The three following addresses were given by invitation of the Program Committee: "Mathematical Aspects of the Boundary Layer Theory," by Professor K. O. Friedrichs, of New York University; "The Structure of Normed Abelian Rings," by Professor E. R. Lorch, of Columbia University, and "Modern Algebra and the Riemann Hypothesis," by Professor André Weil, of Lehigh University.

AN Institute on Dental Health Economics, of which Dr. Kenneth A. Easlick will be the chairman, will be held from June 26 to July 1 by the School of Public Health of the University of Michigan.

THE Pan American Union has announced the publication of a new series of ten volumes entitled "Higher Education in Latin America," to be issued by the Division of Intellectual Cooperation. The series has been made possible through a grant from the Rockefeller Foundation.

THE National Electrical Manufacturers Association is reported by *Industrial Standardization* to have made arrangements for the distribution throughout Latin America of a large number of copies of a Spanish edition of the National Electrical Code. It is believed that the translation of this code will be helpful in promoting Pan-American cooperation in standardization activities. The documents will be distributed by the office at Buenos Aires of the Inter-American Department of the American Standards Association.

IT is announced that the Textile Research Institute, New York City, has purchased the Morton estate at Princeton, N. J., for conversion into laboratories. The property includes an eighteen-room stone house on the north side of Lake Carnegie. As soon as the necessary changes can be made in the building, the research work of the Textile Foundation, now at the Bureau of Standards, Washington, will be transferred to Princeton. It will continue under the direction of Dr. Milton Harris, who is director of research for both the foundation and for the institute.

IT is reported in the *British Medical Journal* that a Swiss Society for Tropical Medicine has been founded at Berne under the presidency of Dr. P. Thillot, of Lausanne, and that an Institute for Tropical Medicine has been founded at Basle.

ACCORDING to a communication dated April 10 from the Delhi correspondent of *The Times*, London, Professor A. V. Hill, secretary of the Royal Society, who was expecting to return to England after a stay of five months in India, stated that a visit of Indian scientific men to England had been arranged to take place in May. The delegation includes Colonel Batra, deputy Director-General, Indian Medical Service; Sir S. S. Bhatnagar, director of the Board of Scientific and Industrial Research; Sir J. P. Ghosh, of the Bangalore Institute, and two physicists, Professor S. K. Mitra and Professor M. M. Sar, of Calcutta. *The Times* reports that in speaking of the scientific aspect of the national development of India —upon which he had been asked to advise the Government—Professor Hill "emphasized the need of a great increase of scientific education, particularly in the higher stages. That would involve that young Indian scientists, engineers and doctors should go abroad for advanced study and training, and that specialized institutions should be set up in India where people could be trained to the high standards required to-day. The natural resources of India were very great, but nobody knew exactly what or where they were. The zoological survey of India was at present little more than a museum, and the botanical survey had not had a director for the past seven years. He wanted to see more research carried out in the teaching institutions, and a strong central organization for dealing with problems of research. Public health required attention most urgently. According to the last published census returns, 450 children out of every 1,000 died before they reached the age of 15, and too many people in India died from preventable diseases."

ACCORDING to the daily press, an agreement has been reached between China and the United States under which China is to receive American assistance in the development of her agricultural and forestry enterprises. China will send from ten to twenty-five technicians to America for advanced study and practical training, and the United States will appropriate lend-lease funds for the purchase of agricultural equipment for China.

DISCUSSION

STREAM DOUBLE REFRACTION STUDIES ON THE ORIENTATION OF TOBACCO MOSAIC VIRUS PARTICLES

IN earlier publications[1, 2] we reported that sols streaming horizontally from a small tube (.5 mm inside diameter) through a vessel containing the sol show double refraction throughout the width of the stream if the particles are rod-shaped, and only along

[1] W. N. Takahashi and T. E. Rawlins, *Proc. Soc. Exper. Biol. and Med.*, 30: 155, 1932.

[2] W. N. Takahashi and T. E. Rawlins, SCIENCE, 77: 26, 1933.

the edges of the stream if the particles are plate or disk-shaped. It was assumed that in all cases the longest axis of the particles was oriented parallel to the direction of flow, and that the flat surfaces of plate or disk-shaped particles were parallel to the surface of the cylindrical tube. Disk-shaped particles show maximum form double refraction when the transmission direction of the incident light is parallel to the flat faces of the disks and minimum double refraction when perpendicular to the flat faces. Light transmitted in a vertical direction should therefore produce strongest double refraction along the edges of the stream where most of the particles have their flat surfaces vertical and should produce minimum double refraction in the middle portion where most particles in the upper and lower regions of the cylindrical stream have their flat surfaces in a horizontal position.

We have recently modified the technic by using several types of compensators in studying the magnitude of the birefringence and the orientation of particles. Evidence has thereby been obtained indicating that our above conclusions should be modified to some extent. These studies indicate that flowing rod-shaped particles of tobacco mosaic virus do not produce uniform birefringence throughout the width of the stream but show less birefringence in a narrow central portion of the stream than in adjacent regions on each side of the center. In the regions showing strongest birefringence tobacco virus particles were not found to be exactly parallel to the direction of flow but to have their forward ends tilted toward the middle of the stream at an angle (α) of approximately 15° to the direction of flow.

Langmuir[3] studied the stream double refraction of several sols flowing downward within a pipette (8 mm inside diameter). He stated that "the presence of a dark central band is characteristic of particles which are disks or flat plates. Rods become oriented in the direction of flow which is also the direction of shear, and so give transmission over the whole width of the tube. Disks or plates in a non-crystalline liquid should become oriented with their planes parallel to the tube axis, but perpendicular to the radius of the cylinder through the particle, for these planes are tangent to the surface of shear. If the particles are circular disks, they should not change the plane of polarization of light passing through the axis of the tube and thus there should be a black band in the axis when the crossed polaroids are at 45°. If, however, the particles are plates which are longer than they are broad, so that their long axes are oriented parallel to the tube axis, the intensity of the central band should serve as a measure of the ratio of width to length." He observed a tilting of plate-shaped bentonite particles relative to the direction of flow in the edges of the stream within the pipette. Langmuir explained the tilting by assuming that the bentonite particles are oriented in a cubic lattice. When subjected to shear caused by flow he assumed that the position of the particles is changed from the cubic arrangement to a parallelogram arrangement and that the repulsive forces between the particles are modified as a result of the changed arrangement, causing the tilting of the forward ends of the particles toward the center of the stream.

[3] *Jour. Chem. Phys.*, 6: 873, 1938.

Bernal and Fankuchen[4] were unable, by means of x-ray diffraction methods, to detect any evidence of spacings corresponding to the length of tobacco mosaic virus particles. They therefore assumed from their evidence that the particles in the "virus crystals" are oriented in 2 dimensions but not in the third dimension. Langmuir accepted this interpretation and stated that in very old V_2O_5 sols, "as in tobacco virus solutions, there is probably no regularity of micelle arrangement in directions parallel to their length, so that the forces . . . which cause the tilting are absent. In new V_2O_5 sols, however, the shorter particles permit a three-dimensional rather than a two-dimensional lattice arrangement and so give $\alpha \neq 0$."

We have studied tobacco mosaic virus by means of Langmuir's pipette technique and, as in the stream expelled from the small tube, find a lower birefringence in a narrow central band in the center of the stream than in adjacent regions on each side. Again we also find the tilting of the particles relative to the direction of flow in the most birefringent portions on each side of the central band. This evidence will be given in detail in a later publication.

We would suggest that the unexpected low birefringence observed in the middle of the stream of rod-shaped tobacco mosaic particles is probably due to the particles in the portion of the stream nearest the observer having their forward end tilted away from the observer and those in the portion opposite the observer having their forward end tilted toward the observer. Particles in such positions should produce lower form birefringence than if oriented in a direction parallel to flow.

If Langmuir is correct in assuming that the tilting of particles in a stream is dependent on a 3-dimensional lattice arrangement of the particles the obvious conclusion from our results would be that there is a 3-dimensional orientation of tobacco mosaic particles.

Recent results with the electron microscope[5,6,7] indicate considerable variation in the length of tobacco

[4] *Nature*, 139: 923, 1937.

mosaic particles. Approximately 70 to 80 per cent. of the particles have a length close to 3,000 Å; most of the remainder have a length between 750 and 2,250 Å. It is evident from these results that, if there is orientation in the third dimension, the characteristic spacing could be as great as 3,000 Å, a value too great to have been detected by the x-ray technique used by Bernal and Fankuchen.[8] Their x-ray results therefore can no longer be considered evidence against a 3-dimensional orientation of the particles. If there is orientation in the third dimension it would probably be much less perfect than in most crystals because of the variation in the length of the virus particles.

From the above discussion it is evident that our suggestion of a 3-dimensional orientation of tobacco mosaic particles is based on Langmuir's evidence that tilting of particles is dependent on a 3-dimensional arrangement. If the tilting is not dependent on a 3-dimensional arrangement but on other factors mentioned by various workers,[9] assumption of a 3-dimensional orientation of tobacco mosaic virus particles would be unfounded.

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[5] W. M. Stanley and Thomas F. Anderson, *Jour. Biol. Chem.*, 139: 825, 1941.

[6] T. E. Rawlins, SCIENCE, 96: 425, 1942.

[7] T. E. Rawlins and Nedra M. Utech. Unpublished results.

[8] J. D. Bernal and I. Fankuchen, *Jour. Gen. Physiol.*, 25: 111, 1941.

[9] J. T. Edsall, *Advances in Colloid Science*, 1: 269, 1942.

THE INCOMPLETENESS OF SOME ECOLOGICAL GRASSLAND STUDIES

As an ecological factor in pastures, the wild animal life, consisting mostly of small inconspicuous invertebrates, must at least be considered, even if it is thought not to equal in its effect the feeding of domestic animals, the competition of weeds or the vigor of the different species of the grasses themselves, and the physical environmental factors of topography, soil and climate. The neglect of this factor of the smaller wild animals may lead to serious errors. For, incredible as it may seem, in many a pasture grazed not too close to its carrying capacity, the obvious cows and horses are not as great a bulk as the total weight of insect and other wild animal life existing there. Ants and leafhoppers are especially numerous in grasslands, but because of their small size, the effect of their presence is not so marked as that of grasshoppers, cutworms and white grubs, which eat almost as much of the pasturage as do the domestic animals.[1] The statistical studies conducted on grasslands in England and of a considerable variety of environments elsewhere[2] have, unfortunately, not been carried far enough to show how much each species of insect, spider, millipede, snail, earthworm and nematode adds or subtracts from the vegetation of the area, and what is the total effect of their combined impact. In the numerous studies of grasslands now being conducted because of the value of such areas in soil conservation, no more fruitful project is open, and the failure to include such records of the wild animal life of pastures and meadows is sure to result in a seriously distorted picture.

"An Ecological and Grazing Capacity Study of the Native Grass Pastures in Southern Alberta, Saskatchewan and Manitoba"[3] mentions not a single insect, yet it is preposterous to suppose that no grasshopper disputed with the domestic live stock as to which should eat the grass of these Canadian pastures. "Pastures of Puerto Rico and Their Relation to Soil Conservation"[4] also says not a word of the insects that feed on the pasture grasses of Puerto Rico. Admittedly, however, it does not leave out all mention of insects, for concerning the weed "botoncillo" it states: "It is host plant for the beneficial wasp *Larra americana,* which is a parasite on changas or mole crickets." Reassuring as it may seem to have one's pet parasite introduction project[5] thus signalized for mention, it raises the disturbing suspicion that this may be only the doubtful reward of undue propaganda.

Dr. Herbert Osborn has written an entire book about "Meadow and Pasture Insects" of North America. In the tropics, as elsewhere, the effect of insect life in grasslands may be conspicuous, and is especially obvious when an attempt is made to replace native grasses. The Agricultural Experiment Station at Mayaguez has reported[6] the susceptibility of Java grass, *Polytrias amaura,* to the attack of the chinch bug, but nevertheless it was planted at one of the naval bases in a region of Puerto Rico where chinch bugs are notably scarce on all native grasses. Despite a rainfall normally excessive for chinch bugs, the favorable factor of a very susceptible grass enabled them to become so abundant as to kill the grass in large patches, and render the entire lawn so yellow as to contrast unfavorably with the standardized dirty green camouflage of the buildings. At an army post in

[1] *Ecological Monographs*, 7 (1): 1–90, January, 1937.

[2] See Bibliography, *Bull. Chicago Acad. Sci.*, 6 (4): 63–124, August, 1941.

[3] Tech. Bull. No. 44, Dominion Experiment Station, Swift Current, Saskatchewan, September, 1942.

[4] Misc. Pub. No. 513, U. S. Department of Agriculture, May, 1943.

[5] *Jour. Econ. Ent.*, 34 (1): 53–6, April, 1941.

[6] Report Puerto Rico Agricultural Station, 1936.

Puerto Rico, the planted Bermuda grass was being eaten by changas, *Scapteriscus vicinus* Scudder, although just outside the post, the native gramma grass, *Stenotaphrum secundatum*, flourished with undiminished vigor.

It should not be thought, however, that gramma grass, or any other native grass for that matter, will survive insect attacks under all conditions. Indeed, when supposedly ideal conditions are being artificially supplied for the grass, these may be even more favorable for some particular insect pest. Thus, a circle of yellow gramma grass surrounding the head of an underground sprinkler system was found to mark the limits of an exceptional abundance of a leafhopper, *Kolla fasciata* Walker, present in only normal numbers elsewhere on a lawn near Aguadilla, Puerto Rico.[7] Naturally, also, native vegetation has specific native pests, and large areas of gramma grass may have all the blades eaten down to the sprawling stalks by the little green Pyralid caterpillars of *Psara phaeopteralis* Guenée. These are only a few of the more obvious examples of the effect produced by specific members of the wild animal life of grasslands, but are ample to illustrate the necessity for including them in all ecological studies of pastures and meadows if these are to be considered at all complete.

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PROPER CREDIT FOR DISCOVERY OF "A RELATIONSHIP BETWEEN DENTAL CARIES AND SALIVA"

IN the March 31, 1944, issue of SCIENCE, Turner and Crane[1] report that they have discovered "a clear relationship . . . between the rate of starch hydrolysis by saliva and the incidence of caries in the individual." The note gives the impression that the finding is new, as indicated by the part quoted here and the absence of any reference to other work on this subject. Therefore, attention should be called to the fact that in 1941 Florestano, Faber and James,[2] using a much larger number of subjects, discovered and reported essentially the same results and conclusions. Consequently, credit for the finding should go to the latter group of workers.

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SCIENTIFIC BOOKS

PLANT VIRUSES

Plant Viruses and Virus Diseases. By F. C. BAWDEN. Second edition. xi + 294 pp. Waltham, Mass., Chronica Botanica Company. 1943. $4.75.

THE book represents an attempt to describe and correlate advances that have been made in the study of plant viruses during the last decade. It deals largely with less than a dozen viruses whose chemical and physical properties have been studied somewhat intensively. Such emphasis on the chemical and physical phases of virus work is perhaps justified, since it is in this field that plant virus research has made remarkable advances in recent years, but I suspect that most plant pathologists would prefer a book discussing virus diseases more broadly. On the whole the book is unusually well written and well illustrated. Biochemical and biophysical phases of plant virus research, especially, are presented accurately and entertainingly, although some descriptions of chemical methods seem unnecessarily long and detailed.

It is unfortunate that in a book of such excellence there should be some serious errors. Chapter 5, which the author states needed extensive alterations in the preparation of a second edition because of the growth of knowledge regarding the relationships between viruses and their insect vectors, may be cited in this connection. In discussing the latent period of viruses in insect vectors the author states on page 76 that the latent period "seems to start from the time the vectors leave the infected plant rather than from the start of feeding on it." The reviewer knows of no evidence anywhere in plant virus literature to support this statement. In discussing such viruses as aster yellows, whose vectors have prolonged latent periods, he states that "in published work there is no indication that vectors can ever infect healthy plants immediately after leaving infected ones." As a matter of fact such cases are reported in the literature. In discussing Black's evidence that the virus of aster yellows multiplies in the vector *Cicadula sexnotata* on page 80 he states, "it is noticeable that the number of successful inoculations is usually greater if the extracts of macerated insects are diluted 1/1000 than if diluted 1/100 or 1/10." This statement is misleading because Black's data do not indicate that dilutions at 1/1000 give more transmissions than dilutions at 1/100 or 1/10. Perhaps the most unsatisfactory section in the chapter is that dealing with work by Fukushi. The author cites the same two papers, published in 1934 and 1935, that were referred to in the first edition and makes essentially the same arguments against Fukushi's evidence that rice stunt virus multiplies in the vector. In papers published in 1939 and

[7] *Jour. Econ. Ent.*, 33 (3): 584, February, 1940.

[1] N. C. Turner and E. M. Crane, SCIENCE, 99: 262, 1944.

[2] H. J. Florestano, J. E. Faber and L. H. James, *Jour. Am. Dental Assoc.*, 28: 1799–1808, 1941.

1940 Fukushi has brought evidence for multiplication in the vector which the reviewer considers overwhelming. The 1939 paper at least must have reached England, for it is abstracted in the *Review of Applied Mycology*. In any case, the discussion relating to multiplication of viruses in insects is unsatisfactory. Carelessness in citing literature is not confined to references regarding the researches of others but extends to some references made to Bawden's own papers. On page 162, for example, he quotes two papers by Bawden and Pirie, published in 1936 and 1937. The 1936 paper cited is not pertinent to the subject under discussion. Another paper by Bawden and Pirie published in 1936, which should have been cited, is not mentioned. The 1937 paper is incorrectly cited.

Chapter 1 gives a brief account of the history of plant virus research. Chapters 2 and 3 describe symptoms associated with representative virus diseases on different hosts and under different conditions. Chapter 4 discusses transmission by various methods. A rather complete list of the viruses known to be spread by insects is given. A statement on page 60 that sugar-cane mosaic is transmitted by aphids and by a leafhopper is in error. Sugar-cane mosaic is not known to be transmitted by any leafhopper.

Chapter 6 on virus strains, mutations and acquired immunity is one of the best. The new conception that most viruses exist in a number of strains has done much to clarify virus disease problems; this the author brings out forcibly. He discusses two types of behavior in virus-infected plants that have been described under the term "acquired immunity." The first type covers cases in which a disease is severe in the acute stage but mild in the chronic stage. The second covers cases in which plants affected by one strain of a virus become immune from infection by other strains of the same virus.

Serological reactions of the plant viruses are dealt with in Chapter 7, where the author shows how precipitin reactions, complement fixation, neutralization of infectivity and anaphylaxis reactions may be used in identifying viruses and in showing relationships between them as well as in quantitative measurements.

Chapters 8, 9, 10, 11 and 12 cover methods of purifying viruses, properties of purified virus preparations, optical properties of purified virus preparations, inactivation of viruses and sizes of virus particles. Chapter 13, on the physiology of virus-diseased plants, enumerates most of the chemical changes known to take place in affected plants. It is the reviewer's opinion that the book would have been improved if in these chapters more emphasis had been placed on the numerous experiments performed by Stanley and his associates in proving that the so-called virus protein isolated from plants affected by tobacco mosaic had the properties of tobacco mosaic virus, since it was this work that initiated a new era in virus research. In chapter 13, also, the movement and multiplication of viruses in different tissues are discussed.

Chapter 14 is on the naming and classification of viruses, and chapter 15 on control of virus diseases. In the last chapter, chapter 16, various views as to whether or not viruses are living and theories of their origin and mode of increase are presented.

The author has undoubtedly succeeded in describing and correlating recent advances in the study of plant viruses in the second edition in a more thoroughgoing way than in the first. It seems safe to predict that this edition will be received with the same enthusiasm that was accorded the first.

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ANOPHELES GAMBIAE

Anopheles gambiae in Brazil, 1930 to 1940. By FRED L. SOPER and D. BRUCE WILSON, 262 pp., 75 figs. New York: The Rockefeller Foundation.

WHEN we fight a common enemy we expect to share with our allies the burden of the cost of the war. If the fighting takes place in foreign lands, it is to our advantage, but by no means does that lessen our obligations. Brazil, with the aid of the Rockefeller Foundation, recently fought, and won, a war for most of the countries in the New World. The enemy was not a political one, but nevertheless is capable of great destruction of life and property, for it is one of the deadliest disease carriers known—*Anopheles gambiae.*

Anopheles gambiae is native to tropical Africa. Late in 1929 or early in 1930 it was carried across the South Atlantic to Natal, Brazil, probably by one of the fast mail-carrying French destroyers which were capable of traveling between Dakar and Natal in only four days. In the following years it spread along the coast northward from Natal to Caponga, a fishing village only forty-five kilometers from Fortaleza, and from the coast it advanced inland along the river valleys until, by 1940, it had invaded the upper reaches of the Jaguaribe and its tributaries as far as Madelena, Barra de Conceição and Quixará. Its range also included the valley of the Assú River as far as São Rafael, and the Apodí valley as far as São Sebastião and Augusto Severo. The migration was accomplished by infiltration, that is, by short flights from one breeding place to another and by transportation of the adult in various kinds of vehicles.

Almost everywhere the *gambiae* invasion was followed by severe malaria epidemics. The first outbreak occurred at Natal in 1930 and subsided when control measures eradicated the mosquito from that city. In

1931 it raged in river valleys northwest of Natal, but the period between 1932 and 1937 is referred to as the "silent era" because, although it was extending its range, the mosquito caused no noticeable increase in malaria. The epidemic of 1938 in the Jaguaribe valley, in the state of Ceará and along the coast and rivers of the state of Rio Grande do Norte was catastrophic. It was estimated that in June and July there were 100,000 cases of malaria with over 14,000 deaths. In 1939 more than 185,000 people in the two states were given treatment for the disease.

The Brazilian Ministry of Education and Health and the Rockefeller Foundation collaborated in organizing the Malaria Service of the Northeast, with headquarters at Fortaleza. The basic unit of the control organization was the zone—an area in which one man could apply larvicides to all breeding places in one week; or an area in which all houses could be sprayed by a disinsectization squad in one week. The zone inspector was responsible to the chief inspector, whose district generally included five zones. Several districts were combined into a post, which was in charge of a doctor, and the posts were grouped into a total of seven divisions, each of which was in charge of a more experienced doctor.

The severity of the epidemic necessitated the distribution of quinine and atebrine, but the real offensive against the insect involved the painstaking search for larvae in all possible breeding places and the application of larvicides, especially Paris green, by the zone inspectors. The attack on the larva was supplemented by systematic spraying of adult mosquitoes resting in houses; although this measure can not be relied upon for eradication of the mosquito, it did increase the effectiveness of the larvicidal program and prevented many cases of malaria by killing infected adults. But the objective of the counter-attack against *A. gambiae* was not merely to control malaria; it was the complete extermination of the species in Brazil. After surveys had established the distribution of the mosquito, a cordon was thrown about the periphery of its range, and further infiltration into uninfested areas was prevented by the use of larvicides and pyrethrum spray in a belt eight to twenty-five miles beyond the known limits of the infested area, while transportation of the adult through the barrier was prevented by disinsectization of all planes, boats, trains and other vehicles. Control measures were intensified at the border, and, working from this frontier zone inward, one area after another was cleared of the invader, until in November, 1940, the last individuals of *A. gambiae* were destroyed.

This, in brief, is the account of the *gambiae* invasion of Brazil. But the authors do more than simply repeat this story. In addition to emphasizing the need for constant vigilance against such insect invaders, they challenge the old concept of malaria control that aims only at reducing the vector population below a certain level by drainage and other methods that require many years for their success, and which never completely eradicate the disease. Can *A. gambiae* be exterminated from regions within its natural home in Africa? Can *A. pseudopunctipennis* be eradicated from river valleys in Peru? It is true that *gambiae's* habit of breeding in small water collections free of vegetation, and its attraction to human habitations, not only cause it to be a more dangerous malaria carrier but also make it more susceptible to control by larvicides and spraying. Other anophelines which have a wider selection of breeding places and which rest in the jungle may be much more difficult to attack, but would it be feasible to attempt an all-out "blitzkrieg" instead of simply keeping down their numbers by control measures which must be continued forever? Extermination of such mosquitoes may not be possible, but no one thought that *A. gambiae* could be eradicated from Brazil in less than two years.

The book is well worth thoughtful perusal by all those interested in control of insects of economic and medical importance, whether they be doctors, scientists or legislators.

L. E. Rozeboom

SPECIAL ARTICLES

EXTRACTION OF A HIGHLY POTENT PENICILLIN INACTIVATOR FROM PENICILLIN RESISTANT STAPHYLOCOCCI[1]

By grinding a suspension of *E. coli* in a crushing mill, Abraham and Chain[2] in 1940 produced an enzyme-like substance capable of completely inhibiting penicillin. This substance, called penicillinase, was presumably intracellular, for penicillin was not destroyed by the actively growing organisms, and no penicillin inactivator was present in culture filtrates. No penicillinase could be extracted from penicillin sensitive staphylococci, or, in later experiments,[3] from a strain of *Staph. aureus* made insensitive by repeated

[1] The penicillin was provided by the Office of Scientific Research and Development from supplies assigned by the Committee on Medical Research for experimental investigators recommended by the Committee on Chemotherapeutics and Other Agents of the National Research Council.

[2] E. P. Abraham and E. Chain, *Nature*, 146: 837, 1940.

[3] E. P. Abraham, E. Chain, C. M. Fletcher, A. D. Gardner, N. G. Heatley and M. A. Jennings, *Lancet*, 2: 177, 1941.

subcultures in the presence of penicillin. Harper[4] has recently prepared acetone-ether extracts of paracolon bacilli which were more effective penicillin inhibitors than were extracts of *E. coli.*

The purpose of this report is to describe the extraction of a highly potent penicillin inactivator from 7 strains of *Staph. aureus* (coagulase positive). Details of the strains will be presented elsewhere. Briefly, they were "naturally" penicillin resistant; all were isolated from patients who had not received penicillin. The method of extraction was that used by Harper.[3] Saline suspensions of 24-hour plate cultures were precipitated with 7 volumes of acetone. After a change of acetone, and two of ether, the precipitate was dried quickly *in vacuo* and stored at room temperature. For tests of potency, broth suspensions of the powder were added to broth cultures containing a constant inoculum of hemolytic streptococci (about 1 million organisms per cc) and varying amounts of penicillin. A typical experiment is presented in Table I.

TABLE I

PROTOCOL OF A TYPICAL EXPERIMENT SHOWING RAPID, COMPLETE DESTRUCTION OF 100 UNITS OF PENICILLIN BY 1 MGM OF THE POWDERED EXTRACT OF A PENICILLIN RESISTANT STRAIN OF STAPH. AUREUS. TURBIDITIES ARE EXPRESSED IN TERMS OF OPTICAL DENSITY

Tube	Broth plus hemolytic streptococcus	Penicillin	Penicillinase 1 mgm/cc	Sterile broth
1	10 cc	0	0	0
2	9 "	1 cc (1 μ/cc)	0	0
3	8 "	1 cc (100 μ/cc)	1 cc	0
4	0 "	0	1 cc	9 cc

RESULTS

Tube	Initial	4 hours	8 hours	12 hours
1	.07	.29	1 0	1.0
2	.04	.06	.06	.06
3	.14	.17	.30	1.0
4	.18	.18	.19	.18

Optical densities (turbidities) were measured with a Coleman universal spectrophotometer every few hours while the solutions were incubated at 37° C. As indicated in the table, complete destruction of 100 units of penicillin by 1 mgm of the powder was so rapid that at the end of 12 hours growth in this tube was equal to that of the control. Although there were some variations, this same high degree of potency was shown by the extracts of all 7 strains.

Extracts of 7 penicillin sensitive strains of *Staph. aureus* (coagulase positive) were tested in the same manner, using 2 mgms of the powder and only 1 unit of penicillin. In no instance was there any inactivation of penicillin.

Actively growing cultures of the resistant strains caused complete destruction of penicillin in the culture fluid, but the seitz filtrate of the fluid contained no penicillin inactivator. Ability to destroy penicillin was completely lost when a broth suspension of the powder was left at 56° C for 1 hour. Further studies of the properties of this substance are in progress; it is not possible at present to say whether it is the same thing as the extracts of the colon and paracolon bacilli.

The powdered extracts are now being used routinely in this clinic for all cultures of patients who are receiving penicillin.

SUMMARY

A highly potent penicillin inactivator has been extracted from 7 strains of *Staph. aureus* (coagulase positive), all of which were naturally penicillin resistant. No such inhibitor was present in extracts of 7 penicillin sensitive strains of *Staph. aureus.*

Acknowledgment: I am indebted to Miss Mary Beach for technical assistance.

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ENHANCEMENT OF THE IMMUNIZING CAPACITY OF INFLUENZA VIRUS VACCINES WITH ADJUVANTS[1]

FREUND and McDermott[2] reported that an intense, prolonged sensitization to horse serum and increased production of antibody occurred when the serum was combined with a lanolin-like substance and killed tubercle bacilli suspended in paraffin oil. The present report describes the effect of various adjuvants on the antibody production and immunizing capacity of a single subcutaneous inoculation of formalinized influenza virus in animals.

Allantoic fluid suspensions of PR8 virus, which had been rendered non-infectious by the addition of 0.1 per cent. formaldehyde, were blended with paraffin oil containing dead tubercle bacilli[3] and an absorption base known as Falba.[4] Each cc of the emulsion contained 0.4 cc of the allantoic fluid, 0.4 cc of paraffin oil, 0.2 cc of Falba and 1.4 mg of dried, heat-killed tubercle bacilli. The immunizing capacity of a subcutaneous inoculation of 0.5 cc of the emulsion was tested in young adult Swiss mice. For controls a comparable group of mice received the same amount of virus suspended in saline, and a third group received only saline. Mice from each of the three groups were tested for resistance to intranasal instillation of graded amounts of PR8 virus at various

[4] G. J. Harper, *Lancet*, 2: 569, 1943.

[1] From the Laboratories of the International Health Division, The Rockefeller Foundation, New York.

[2] J. Freund and K. McDermott, *Proc. Soc. Exp. Biol. and Med.*, 49: 548, 1942.

[3] The tubercle bacilli, which were the virulent human Jamaica No. 22 strain, were kindly supplied by Dr. M. W. Chase. They were heated at 100° C in the Arnold sterilizer for 30 minutes and after being dried were incorporated in sterile paraffin oil.

[4] Distributed by Pflatz and Bauer, Inc., New York.

times after vaccination. The mice that received the virus in saline were resistant to about 100 MLD of virus at 4 and 8 weeks after vaccination, but after 26 weeks no immunity could be detected. The mice that received the virus plus adjuvants, on the other hand, were resistant to about 1,000,000 MLD of virus at 4 and 8 weeks after vaccination and even after 26 weeks they were resistant to at least 1,000 MLD.

The antibody response in ferrets following intranasal instillation of active PR8 virus was compared with the amount of antibody elicited by a single subcutaneous inoculation (2 cc) of formalinized PR8 virus with and without the above-mentioned adjuvants. The results are shown in Table 1. The antibody titers elicited in rabbits by allantoic fluid suspensions of influenza virus and by concentrated preparations of the virus[5] were likewise increased and maintained at high levels by these adjuvants. The experiments indicated clearly that the adjuvants provide a much more effective method of increasing antibody production to the virus than the use of concentrated preparations of virus alone.

TABLE 1

SERUM ANTIBODY TITERS IN FERRETS FOLLOWING SUBCUTANEOUS INOCULATION OF FORMALINIZED INFLUENZA VIRUS WITH AND WITHOUT ADJUVANTS AND FOLLOWING INTRANASAL INSTILLATION OF ACTIVE VIRUS

Test bleeding weeks	Mean serum antibody titer* of ferrets inoculated with		
	Formalized virus subtaneously		Active virus intranasally
	+ saline	+ adjuvants	
0	< 32	< 32	< 32
2	388	3,010	10,800
4	169	10,100	3,580
6	147	7,650	2,306
10	128	3,010	1,670
14	104	2,200	1,350
18	91	2,520	1,270

* The titers were determined by means of a standard red cell agglutination inhibition test (G. K. Hirst and E. G. Pickels, *Jour. Immunol.*, 45: 273, 1942), and are expressed as the reciprocal of the serum dilution end point. Four ferrets were used for each group.

Further experiments have shown that another acid-fast organism, *Mycobacterium butyricum,* could be substituted for the tubercle bacilli in the emulsions with the same degree of enhancement of immunity against the virus as described above. The acid-fast bacteria were essential in the vaccines, for paraffin oil and Falba alone were less effective. Aleuronat, broth and plain diphtheria toxoid had no detectable effect on the antigenicity of the virus. When influenza virus was sedimented from allantoic fluid by high-speed centrifugation and resuspended in sesame oil together with dried, heat-killed *M. butyricum,* it elicited antibody titers in rabbits which were about 4 times higher than when the sedimented virus was resuspended in saline.

The results make plain that the addition of certain adjuvants to influenza virus vaccines not only greatly increases the immunizing capacity of the virus in experimental animals but maintains the immunity at a high level over a long period. It seems unlikely that the adjuvants employed in the above experiments can be safely used in human beings. Further study of the phenomenon, however, may provide materials which can be utilized in human vaccination. A more complete report will be published at a later date.

WILLIAM F. FRIEDEWALD

[5] G. K. Hirst, *Jour. Exp. Med.*, 76: 195, 1942; T. Francis, Jr. and J. E. Salk, SCIENCE, 96: 499, 1942.

ASCORBIC ACID LOSSES IN MINCING FRESH VEGETABLES[1]

DURING a period of shortage of fresh vegetables, the importance of conserving vitamins is evident. In the preparation of many salads, raw vegetables and fruits are finely minced. In many mess halls vegetables are minced in a machine called the "Buffalo chopper." This machine is merely a bowl set under a pair of rotating blades. These function like the old-fashioned wooden bowl used with a hand chopper for mincing cabbage.

Numerous studies have indicated that maceration speeds the rate of disappearance of ascorbic acid in fresh plant products.[2,3] Enzymes, metallic catalysts and fine division favor oxidation.

A series of studies to learn methods of conserving vitamin C have been completed in the naval hospital cafeteria of the National Naval Medical Center. Spe-

TABLE 1

ASCORBIC ACID LOSSES FROM CUTTING FRESH VEGETABLES (MG/100 GM)

Vegetable	Cutting tool	Freshly cut	30 mins. after cutting	2 hrs. after cutting
Green peppers	Plastic knife	130	128	87
	Steel knife		118	58
	"Chopper"		84	31
Radish	Plastic knife	52	49	35
	Steel knife		41	8
	"Chopper"		36	5
Cabbage	Plastic knife	27	26	19
	Steel knife		8	8
	"Chopper"		7	6
Cucumbers	Plastic knife	14	12	7
	Steel knife		10	5
	"Chopper"		3	2
Onions	Plastic knife	11	10	8
	"Chopper"		2	2
Lettuce	Plastic knife	4	2	1
	Steel knife		1	1
Tomatoes	Plastic knife	13	9	9
	Steel knife		8	8

[1] The opinions and views set forth in this article are those of the writers and are not to be considered as reflecting the policies of the Navy Department.

[2] C. G. King, "Physiology of Vitamin C. The Vitamins." Amer. Med. Assn., Chicago, p. 331, 1939.

[3] M. Pyke, *Nature*, 149: 499, 1942.

cial attention has been given to the knives used for mincing vegetables, since their composition may be important. Furthermore, in large-scale cookery salads are often prepared one or more hours before they are served. Therefore, attention was given to the rate of disappearance of ascorbic acid. All analyses were run by the method of Bessey.[4]

The procedure followed was to remove the vegetables from cold storage. A liberal sample was set aside without cutting. Another sample was thinly sliced with a plastic knife. A third was sliced with a steel knife. A fourth was put through the Buffalo grinder. The samples were then taken to the laboratory. The original time of cutting was recorded.

At the laboratory samples of the intact vegetable were prepared for immediate analysis by mincing on a wooden board with a plastic knife. The other samples were run one half hour and two hours after the initial slicing.

Typical data are shown in Table 1. These data indicate the losses that result from both the knives used in cutting and from the time of standing of the cut vegetable. Possibly some form of plastic bowl and knife can be devised for the "Buffalo chopper." Wherever possible salads should be prepared with large pieces of fruits or vegetables prepared just before serving.

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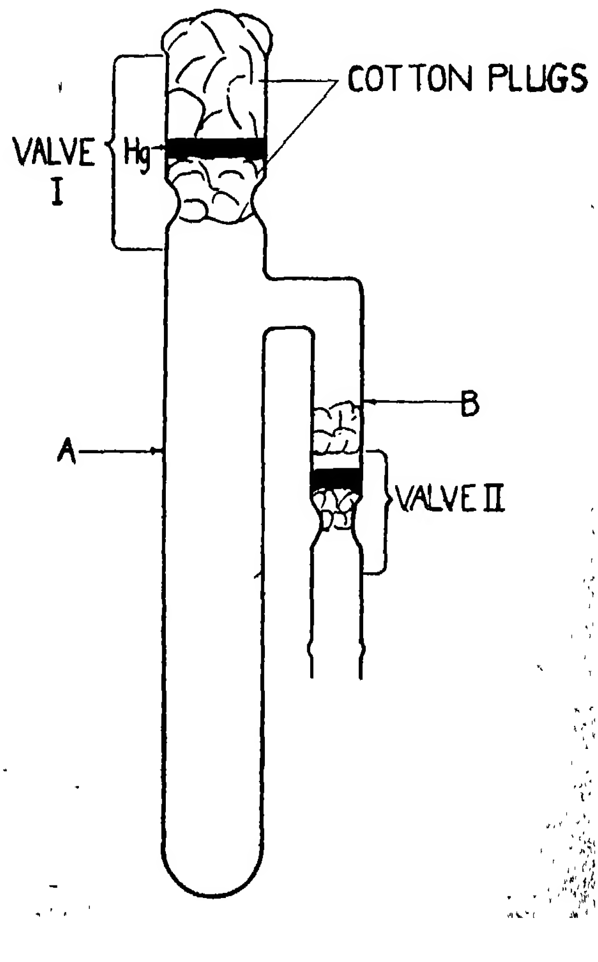
SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLIFIED LABORATORY CHECK VALVE AND ITS APPLICATION IN THE CONSTRUCTION OF ANAEROBIC CULTURE TUBES

Sintered glass filters have been used as one-way or check-valves in a variety of ways.[1] However, besides being difficult to construct, these are relatively expensive. An inexpensive substitute may readily be realized in any laboratory simply by floating mercury over a cotton or glass wool plug contained in the constricted portion of a tube. This valve will not permit the passage of air into the tube, but will relieve the slightest pressure of gas within.

In certain applications a check valve of the type described above possesses an advantage over the sintered glass type. This is particularly true of its application in the construction of bacteriological tubes for the growth of anaerobes. Fig. 1 shows a tube constructed in this laboratory for the cultivation of *Clostridium acetobutylicum*. *A* is a 22 × 175 mm test tube to which tube *B* (approximately 10 mm diameter) is sealed as a side arm. Tube *A* contains a constriction in which a cotton or glass wool plug fits snugly. Mercury is floated over this plug to a depth of at least ½″; and above this mercury a cotton plug is inserted to prevent splattering. A sheet of paper fastened over the open end may be used to accomplish the same purpose. Tube *B* is bent at right angles. Below the bend a check valve is assembled in the same manner as indicated above. The use of the tube is illustrated in what follows.

Medium is introduced into tube A, and the tube and its contents are sterilized with the cotton plugs of valve I, and the plugs and mercury of valve II in place. Following sterilization and cooling, the in-



[4] O. A. Bessey, *Jour. Biol. Chem.*, 126: 771, 1938.

[1] A. A. Morton, "Laboratory Technique, Organic Chemistry," McGraw-Hill, 1938.

oculum is introduced aseptically into *A*, the lower cotton plug is re-inserted and covered with a layer of mercury, and then the upper plug is inserted. Inert gas is introduced through tube *B*, care being taken to regulate the flow so that excessive splattering is avoided. A rate of about 2 cc per minute is not excessive. The gas bubbles through check valve II and out of valve I. The tube following the displacement of air is now ready for incubation. Gases formed in *A* are vented through valve I. Following active fermentation the tube remains sealed against losses of volatile substances.

Following a run, check valve I is readily disassembled, and the tube may be cleaned and prepared for the next run. Valve II may also be disassembled to facilitate cleaning.

An advantage over sintered glass disc filters lies in the ease with which valve I is disassembled to permit the introduction of inoculum, and to permit the cleaning and re-use of a tube.

If more thorough displacement of air is desirable a tube connected to *B* by means of an inner seal and leading to the bottom of *A* may be introduced. With certain organisms, side arm *B* and valve *II* may be dispensed with. Thus with heavy inoculum of *Cl. acetobutylicum,* growth may start at the bottom of the medium, and gases given off may render conditions sufficiently anaerobic for fermentation to proceed.

In using glass wool plugs as supports for the mercury, care should be taken to prevent loose fiber from extending too far into the mercury, a condition which permits leakage of air into the tube.

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A CANNULA WITH OBTURATOR FOR USE IN ARTERIAL PRESSURE MEASUREMENTS ON SMALL ANIMALS

IN the course of experiments on rats subjected to severe hypothermia, attempts to measure the arterial pressure using the conventional type of arterial cannula failed because of repeated clotting in the constricted portion of the lumen. A cannula provided with a closely fitted obturator which could be left within the narrow tip except during actual registration of pressure aided greatly in maintaining a patent recording system.

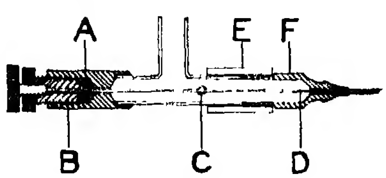

FIG. 1

The cannula was constructed from a 22 G. hypodermic needle (F), with the shaft of the needle cut to 6 mm and the flanges of the hub ground off to form a smooth cylinder. The needle tip was ground to a blunt bevel. The body of the cannula, to which the needle was joined by a short piece of rubber tubing (E), was made of a T tube of 5 mm glass tubing with each arm of the T cut to a length of 1 cm. The sliding obturator (D) was arranged in the longer axis of the cannula so that it moved within a brass gland (B) cemented to the glass T tube and filled with graphite-impregnated packing (A). The nickel-silver obturator was soldered to a threaded plug which could be screwed firmly into the gland. On the shaft of the obturator was fixed a bead of solder (C) in such a position that it would arrest the movement of the shaft when it had been withdrawn far enough to remove the tip from the lumen of the needle. With the cannula assembled, the obturator pushed completely into the needle and screwed into place, the obturator was ground to a bevel to match that of the needle.

The use of the cannula involved the usual procedure of filling the cannula and recording system with anticoagulant solution, securing the cannula within the vessel and balancing the pressure in the manometer system against the expected arterial pressure. Communication between the artery and the recording system was accomplished by withdrawing the obturator long enough for the desired measurement of pressure. In the intervals between measurements, the obturator was pushed into the lumen of the needle and left in place until the next determination. Thus any blood clot which had formed in the needle during the course of pressure recording was broken up and pushed out of the cannula.

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THE IMPORTANCE OF COOPERATIVE STUDIES OF THE BIOLOGY OF MAN

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MAN is to-day the most studied of animals. He is being investigated by anthropologists, anatomists, physiologists, bacteriologists, parasitologists, pathologists, geneticists, psychologists, psychiatrists, ecologists and other specialists in many sub-branches of the broad field of biology. Most of these investigators are fully competent and the results of their researches are of high value. An increase in the volume of research in every one of these fields would be profitable and very desirable. I venture to suggest, however, that in addition to the studies now being made of man in each of these special divisions of science, it would be highly profitable to study also the whole man in relation to his heredity and to his environment. In making this suggestion I am well aware that numerous investigations of man now in progress or recently completed involve several diverse subdivisions of biology. However, no investigation or group of investigations now in progress is in my opinion sufficiently comprehensive to secure anything like a complete picture of man the animal, as he exists in this constantly changing world.

Every human being is the product of his heredity and of his environment. Arguments about which of the two is the more important are futile, because no group of hereditary factors in sperm or egg can produce an individual organism except through interaction with the environment. Neither can the environment produce any organism without the presence of a group of hereditary factors combined in a reproductive unit of some kind. We can and should, however, measure to the best of our ability the role that each hereditary factor and each feature of the environment plays in the production and maintenance of the individual and of the race and species.

The importance of heredity in the development of

each individual man is attested by the many resemblances in physical characters and in behavior that characterize the members of the same family. The evident differences between some brothers and sisters and other close relatives may in part be due to recombinations of genes and therefore may also to this extent be based on heredity. In fact, we can be sure that all human characters of whatever kind have an ultimate basis in heredity, however much the environment may mold and change the hereditary tendencies.

The characters of man that are inherited include not only his anatomical features, but also his physiology and his psychology. For instance, each of the races of man is distinguished by certain physical characters, but it is recognized by anthropologists that many races also exhibit clearly marked peculiarities of physiology and of psychology. It will of course be admitted that psychological and physiological characters are perhaps somewhat more subject to modification by the environment than are anatomical ones.

The effect of any particular feature of the environment on an organism can only with great difficulty be determined unless the heredity of the organism concerned is known with certainty. It is evident, therefore, that the best method for attack on the problems of human heredity and of environment is to investigate families as groups. Although the heredity of human families will never be as uniform, except in identical twins, as the heredity of the closely inbred strains of laboratory animals, nevertheless certain familial factors can be identified. These hereditary trends within families give a basis for studies of the variations in morphology, physiology and psychology that are produced by environmental influences. The difficulties in carrying out studies of family groups are formidable and the complexities involved are confusing. Nevertheless, this method of attack is in my opinion fully feasible and offers the only possible way of untangling in human affairs the complex interrelations of heredity and environment.

Numerous kinds of genes are known to produce multiple effects both in man and in animals. Thus a gene that produces dislocation of the lens of the eye (*ectopia lentis*) in man also sometimes produces an elongation of the long bones, especially those of the hands and feet, spinal curvature, elongated skull, underdeveloped musculature, infantilism and other abnormalities. This particular multiple effect or syndrome is called arachnodactyly.[1] Some genes that affect the morphology of the body also undoubtedly affect the physiology and psychology of the individual. Unfortunately, we know as yet relatively little about the heredity of these latter kinds of multiple effects.

[1] Harold F. Falls and C. W. Cotterman, 1943, *Arch. Ophthalmology*, 30: 611.

We may even suspect that most or perhaps all genes have multiple effects and that, for instance, a gene which affects mentality probably produces also some definite morphological or physiological effects, if we only knew where to look for them. Here would seem to lie one of the most important practical values of comprehensive and coordinated studies of man. If we can identify a gene that produces several effects, then, when we find a person showing one of the effects, we can watch for the development of the others. For instance, how valuable it would be if we could discover some multiple effect, evident early in life, of the presence in an individual of a tendency toward Huntington's chorea. This is a disease that produces uncontrollable muscular movements and mental degeneration. The disease only appears in middle life, often after the individual has already produced children. The character is dominant in heredity and each child of an affected parent therefore has one chance in two of developing the same distressing malady. Could the children who have the defective heredity be certainly identified, they could then be given proper care, the production by them of offspring could be discouraged, and their brothers and sisters who are free of the defect could be relieved of the terrible apprehension that they also may in time be victims of the disease.

Another biological mechanism through which characters are associated in heredity is linkage. Genes that are located on the same chromosome tend to be inherited together, though there is a certain measurable chance of crossing-over, which results in a recombination of characters. In man there are only twenty-four pairs of chromosomes, one pair of which are the X and Y chromosomes that determine sex. There are therefore twenty-four possible linkage groups. Linkages between sex and several other kinds of characters, such as red-green color blindness and hemophilia, have already been described. Little progress, however, has so far been made in the recognition of linkages in human heredity between factors carried by the autosomes, though many such linkages have been identified in other animals and in plants. Linkages between the genes that control human characters must of necessity be very numerous. Their discovery would be of enormous practical value as a basis for advice in human heredity.

The identification of any of the hereditary factors of man will enable more exact studies to be made in the special fields of anatomy, physiology or psychology involved. Conversely, any improvement in the diagnosis of a pathology or of a particular type of behavior gives a basis for more precise studies of heredity. Advances in any one special field of the biology of man therefore will be of aid more or less directly to all other branches of human biology.

The physical and mental characters of man are evidently produced by the extremely complex interaction of numerous hereditary and environmental factors. The identification of these factors and the unraveling of their interactions can only be accomplished through the cooperation of research workers having special training in many diverse fields of biology. No one individual can possibly have the competence or the time needed for all these studies. On the other hand, if each investigator is working wholly independently, the information secured is likely to be haphazard and the problems involved will not be attacked in the most effective manner.

The study of the biology of man will be most effective, I am convinced, when a very intensive study is made of a relatively small number of families, rather than when a larger number of families is studied less intensively. In my opinion, the very best results will be secured when precisely the same families are studied from many different morphological, physiological, psychological and environmental viewpoints.

The families selected for study should be sufficiently large in the number of members they contain to allow of statistical evaluations of the results. The individual members of the family also should reside close enough to the research center so that they may be studied in detail and, if necessary, repeatedly. Furthermore, the members of the family must be willing to cooperate to the extent of furnishing information about themselves and of submitting to the essential examinations and tests. It is our experience at the Heredity Clinic of the University of Michigan that many such families can be found and that most persons are interested in and concerned about their health, their abilities and their heredity.

The data obtained in the course of such comprehensive studies as are here advocated must be filed and preserved with scrupulous care. The importance of these records can not be overestimated. They must be preserved in some central office where they will always be available to the investigators concerned. On the other hand, much of the information obtained will be of a highly confidential nature and the records must therefore be fully protected against misuse. They should be accessible only to the qualified investigators of the cooperating group. Although graduate students and other assistants may aid in the collection of some of the data these persons should not have access to the bulk of the accumulated records.

The required observations and measurements of the several members of a family will of necessity be made by numerous different observers. These observers will include anthropologists, geneticists, physiologists, ecologists, dentists, physicians and specialists in many other diverse fields. Each of them will have a different view-point and to a considerable degree a different scientific vocabulary. Nevertheless, each of them needs to be able to understand and at least in part to interpret the work of the others. Clarity and uniformity in the keeping of the records is therefore essential. Shorthand abbreviations and unusual terms should be avoided. The records should somewhere contain a clear description of each measuring instrument used and of the units in which it is calibrated. The observer must keep in mind the fact that in time instruments, methods and terms change, and that within a few years he himself may not be able to recall the manner in which certain of his data were secured.

The several members of the families selected for study should be examined and measured for their anthropological characters, for their medical history and present condition, for their physiological processes, for their reactions and intelligence and for any other measurable characters that they exhibit. So far as possible the conditions of their environment at the various periods in their life also should be measured and evaluated. Unfortunately, no satisfactory measures have been as yet devised for most features of man's environment nor for the effects of this environment on his physical and mental characters. It is true that the effects of extreme variations in some of the factors of the physical environment and of deficiencies in certain food elements may roughly be evaluated. Some slight beginnings also have been made in the development of technics for the measurement of man's psychological and social environment. Additional and improved technics in this division of ecology are greatly needed.

Many human characters develop at particular ages. Full body size, for instance, is attained only in the second decade of life. Numerous types of inherited pathologies are not evident at birth, but first appear later in life, some of them only in middle life or in old age. The age when a certain type of inherited pathology appears may differ in different families. This may indicate either (1) that the pathology in question is due to a different gene in each family, (2) that the age of appearance is controlled by different modifying genes or gene complexes in the various families, or (3) that the time of appearance is modified by differences in family environment. In any case it will be desirable to study the several members of the families being investigated over as long a period as possible of their life span.

In old age man's physical and mental abilities tend to deteriorate, though the rate of deterioration differs in different individuals. It seems very likely that this rate of deterioration may in part be based on differences in heredity, as well as upon differences in envi-

ronment. Olson and Hughes[2] have shown that the rate and type of growth in children tend to more similarity within families than between families. This strongly suggests that hereditary factors in part control the type of growth in man. It would then be particularly valuable if the same families could be studied intensively from birth, through maturity, to old age and death. Such a study would of necessity require the cooperative aid of a succession of investigators. The agency carrying out such a long-continued study must accordingly be a permanent one.

In setting up a research program for the study of man there should be no thought of ultimately establishing rules for the conduct of the people. While the scientists who investigate particular families should supply advice to the individuals, to the physicians and to the social agencies concerned, the scientists should never have control over any individual person. Most people are fully responsible and are capable of making use of advice that is to their best interests. The existing laws are in general adequate to take care of socially irresponsible individuals.

The method of setting up a cooperative research program such as I have outlined must differ to some extent in each locality. Even in those research centers where only a few aspects of the program can be carried out much could be gained by coordination of effort. In most places where research in human biology is in progress it is being conducted in numerous different departments and institutions. The independence of the individual investigators and of the departments concerned must of course be maintained. Perhaps an advisory committee set up for the purpose might sometimes suffice to unify the investigations. Such a committee could best serve its purpose if it had control of the record-keeping unit and if it had some funds available to use for filling the gaps that are certain to be present in the research program. Such an advisory committee, however, may have difficulty in maintaining the desired breadth and continuity of research.

The very best organization for carrying out a broad research program in human biology would, in my opinion, be a special unit connected with a large university where researches in many branches of human biology already are in progress. The special unit should be set up particularly to keep long-time records and to cooperate with the departments already carrying on investigations in this field. The special unit further should have funds sufficient to ensure the permanent continuity of the studies. These funds should be adequate (1) to provide a staff for the keeping of the records, (2) to give a reasonable amount of financial aid to cooperating investigators in the several established departments, and (3) to initiate and to conduct necessary studies in fields not covered by any existing department in the locality. I suggest further that the operation of this central unit should be the responsibility of a full-time director or chairman, but that the policies of the unit should be determined by an advisory or executive committee made up of a representative from each cooperating department.

I do not attempt to conceal the fact that for the most satisfactory results a research unit of the type proposed will require a considerable income from some certain and permanent source. While worthwhile information can be secured by the operation of a small unit, much more can be accomplished by the employment of a number of full-time investigators together with their necessary assistants.

A very large proportion of the current research on man now in progress in the United States is being conducted at colleges and universities, mostly by men who have numerous other responsibilities. It is extremely unlikely that any college or university will have the money in hand to set up a cooperative research unit with the breadth needed. It also is unlikely that endowments in the amounts required can be secured from wealthy people, although research grants and endowments are always of great aid in exploring new fields such as this.

The biology of man is of practical concern to every person in the nation. The provision of funds to conduct the needed investigations in this field is therefore the direct responsibility of the state and federal governments. Notable success has been attained in the scientific study of agricultural problems by the federal Department of Agriculture and the several state agricultural experiment stations. The biology of man is certainly of no less importance than the biology of dairy cows and other domestic animals.

Every state should in my opinion maintain and generously support a permanent center for research on man. Such a state research center might perhaps be called a Family Research Institute. Substations could be maintained in other parts of the state. A federal bureau or department might serve in an advisory capacity to the several state institutes and thereby tend to unify their activities, but it should not have control of their research. The state research institutes should investigate the hereditary and environmental factors causing physical and mental illness, juvenile delinquency, social incompetence and other types of human maladjustments. Due attention should also be directed toward a determination of the factors that produce improved physical health, superior men-

[2] Willard C. Olson and Byron O. Hughes, "The Child as a Whole." Ann Arbor, Mich.: Elementary School, University of Michigan. 8 pp., illus. 1939.

tal ability and outstanding social cooperation. The need for research on the biology of man is obvious; methods for conducting the investigations are fairly well worked out; and there is lacking only the leadership to develop an adequate research program and the funds to carry it out.

GEOSYNCLINES IN CONTINENTAL DEVELOPMENT[1]

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GEOSYNCLINES, from the derivation of the word, are great depressions in the crust of the earth. The term has been applied both to large surface depressions and to thick sediments that have filled such sinking areas. The latter concern the stratigrapher. Study of the geosynclines in the interior of North America reveals several classes that differ in original form, in the derivation of their rocks and in their structural and volcanic histories.

In the early Paleozoic, a half-billion years ago, the central part of the continent, the craton, was depressed less than belts on each side, the miogeosynclines. The Cambrian system, first of the Paleozoic, is the earliest that is sufficiently known to permit reconstruction of the whole of the continent. Lower Cambrian is absent in the continental interior, but thick in the bordering belts, beyond a line from west of the Mackenzie through western Alberta, Wyoming and Arizona, and one from Labrador and the St. Lawrence through eastern New York and the Appalachians to Alabama; younger Cambrian is very thin on the craton, thickening beyond its margin. The craton was essentially a platform separated by flexures from the deeper-sinking miogeosynclines.

The more peripheral areas are so little known that there have been several conceptions of their character. Dana's hypothesis of Archean protaxes, popular last century, considered present crystalline ranges to have persisted from early times. The widely accepted theory of borderlands, developed principally by Schuchert, placed long-lived "Cascadia" and "Appalachia" on opposite sides of the continent; these were described as great lands of crystalline, principally granitic rocks, extending from well within the present coasts to beyond the oceanic shores, and persisting from the beginning of the Paleozoic to or beyond the close. The theory of marginal volcanic troughs considers regions beyond the miogeosynclines to have had deep sinking belts of sediments and marine volcanic rocks—eugeosynclines, with smaller areas in linear islands.

The theory of marginal volcanic troughs is supported by direct evidence and induction. The known sections of Cambrian and succeeding Ordovician are of miles of slates, cherts and volcanic rocks, with interbedded coarser detritus such as might have come from nearby islands. In the West, where early Paleozoic is rarely exposed, the persistence of thick marine volcanics in Paleozoic and earlier Mesozoic rocks throughout the belt suggests that the unknown early Paleozoic is similar. Thus the continent is conceived as having the interior craton separated by flexures from the deeper sinking miogeosynclines, with more peripheral belts of eugeosynclines and linear islands.

The edge of the craton did not persist as a simple flexure, as is shown in comparing successive stages of the Middle Ordovician, second Paleozoic system, along the eastern margin and in contrasting them with the mid-Paleozoic Lower Devonian. The Adirondack line can be drawn from Quebec city through the Adirondack Mountains and southern Pennsylvania to western Virginia Successive limestone units thicken eastward from the line, then thicken westward, subsequently thin toward the line from each side and finally the limestone on the west changes to thickening shale on the east. At any time conditions were similar along one side of the line, and in contrast to those on the other. As a result of the movements, the sediments are thinner along the line than on either side. If one draws the same line on a map showing thicknesses of the Lower Devonian limestones there is little correlation, for the maxima of that series lie near the line in the Virginias and pass considerably to the east in New York.

The Upper Ordovician illustrates a third type of geosyncline, the deltageosyncline, in which thick detrital sediments within the craton were derived from uplift beyond the margin. The deltageosynclinal deposits formed in a semilenticular depression centered in Pennsylvania; they coarsen toward highlands made of rocks of the earlier geosynclinal belts to the east. Stratigraphy is similar in sections radiating from the source. Silurian sediments have similar form, but whereas the Upper Ordovician are pre-orogenic, coarser lithologies gradationally overlapping the finer away from the source, the post-orogenic Silurian has the finer gradationally overlapping the coarser toward the source. The Middle and Upper Devonian of New York is a classic section of part of a pre-orogenic deltasyncline; stratigraphic relations were misunder-

[1] Summary of an illustrated lecture presented to many of the affiliated societies of the American Association of Petroleum Geologists during March, 1944, sponsored by the Distinguished Lectures Committee of the Association.

stood until it was recognized that most of the fossils are not limited so much by age as by association with lithologies that intersect chronologic planes. The deltageosyncline is a geometric form; lines of equal thickness—isopachs, reflecting depression, do not conform necessarily to the lines of similar lithology—isoliths, influenced by the many factors affecting the surface of deposition.

The autogeosyncline is illustrated by the middle and late Paleozoic of southern Michigan. There is strong correlation between the basin structure, shown by contours of depression on a single stratigraphic plane, and the isopachs of Silurian and younger Paleozoic sediments. Successive rock units are thickest in the center of the state because that area was sinking most rapidly, the structure developing as the deposits were laid. The Illinois Basin developed similarly during the late Paleozoic. The autogeosyncline in Michigan and the deltageosynclines in Pennsylvania are separated by a less depressed belt that is the northern end of the Cincinnati arch. Autogeosynclines form within the craton without a complementary highland; the causes of their advents and passings are obscure, but they have definite durations. The present structures of some basins reflect their autogeosynclinal origin; other autogeosynclines have been folded and faulted so as to obscure the earlier behavior, or are concealed by sediments of different structural pattern.

The early geosynclines have striking correlation or coincidence with some major structures of the continent. The western belts retained much of their early character until the middle Mesozoic. There are very few west-derived sediments in the miogeosynclinal belt, and they can have come from uplifted eugeosynclinal rocks. In the Nevadian revolution of the mid-Mesozoic late Jurassic, the belt that included eugeosynclines was thrust on the miogeosynclinal belt in some areas, such as central to southwestern Nevada, and was invaded by batholiths. The resultant highlands spread detritus eastward to form the great deltageosynclinal belt of the Cretaceous on the western craton. In the Laramian[2] revolution at the close of the Mesozoic, the miogeosynclinal belt was thrust on the craton along much of its length, and invaded locally by batholiths; folds and minor thrusts formed in the deltageosynclinal belt on the craton. Subsequently, block-faulting in the Cenozoic era behind the thrusts produced the present Basin Range structure.

[2] Nomenclature is simplified by considering the Laramides to be the structures of the Laramian revolution, the Nevadides, those of the Nevadian, etc.

In the East the eugeosynclinal belt was thrust on the relatively narrow miogeosynclinal belt in the Taconian revolution at the close of the Ordovician. Deltageosynclines extended on the craton before and after the orogeny. Deposition in the eugeosynclinal belt terminated with folding and intrusion of batholiths in the Shickshockian disturbance of the later Devonian. In the southern Appalachians, the Appalachian revolution at the close of the Paleozoic thrust rocks of the Ordovician miogeosynclinal belt on the craton. Subsequently, normal faults developed in the lee of the thrusts, producing the rift-bounded geosynclines (taphrogeosynclines) of the early Mesozoic Triassic of the Atlantic Coast. Thus the structural sequence in the East closely resembles but antedates that in the West. The times of some of the events in each region are not as precisely known as the statements suggest. Moreover, this is but a description of the development of two orogenic belts; one must not assume that all had the same history.

The relationship of the Appalachian Structural Front, the northwestern major fold of the mountain system, to early geosynclines, emphasizes their plurality. The Front lies within the late Paleozoic Lower Pennsylvanian miogeosyncline from Alabama to central Virginia, where the folds trend northward in an arc into central Pennsylvania, leaving the miogeosyncline to enter an area having thick medial Paleozoic deltageosynclines. The folds tend to coincide with the area of greatest thickness of sediment, but the latter is composed of geosynclines of different types and ages. The cratonal flexure of the Lower Pennsylvanian miogeosyncline lies west of the Adirondack line, defining the Ordovician miogeosyncline, crosses it about Maryland, and is to the east in the north. Thus there is not an Appalachian geosyncline, but there are geosynclines of several sorts and of differing ages in the Appalachian region.

This has been an endeavor to emphasize distinctions among North American geosynclines, and express them in classification. Not all geosynclines are as typical, for some have been formed under plural influences, others are of sorts that have not been considered. The discussion may give a better understanding of the continental plan—if it encourages closer analysis of the deposits that confront the geologist, it will serve a good purpose.

OBITUARY

JESSE G. M. BULLOWA

In the death of Dr. Jesse G. M. Bullowa, since 1928 clinical professor of medicine at New York University College of Medicine, science lost a keen and competent research worker, medicine an experienced practitioner and teacher and numerous patients a [illegible]

and versatile physician. As a colleague of long standing remarked, it will take many men to pick up the threads of his diverse activities.

Dr. Bullowa was born in New York City on October 19, 1879, and following his graduation from the College of the City of New York (1899) studied medicine at Columbia University, where he won a graduation prize (1903). He served as consulting physician at several hospitals and as visiting physician at a number of others, including Riverside Hospital, Willard Parker Hospital, the Municipal Sanitarium at Otisville, N. Y., and Harlem Hospital, where he was in charge of the pneumonia service. In collaboration with the late Dr. William H. Park and others, he developed efficient methods for the treatment of lobar pneumonia with refined specific antibacterial sera, quite a task when one remembers that apart from other kinds of etiological organisms, there are about fifty recognized types of pneumococci. He died on November 9, 1943.

He also did pioneer work in the development and use of oxygen tents in the treatment of pneumonia, and enlisted the aid of Mr. Lucius Littauer, serving as trustee of the Littauer Foundation, endowed to finance medical research. In 1936, Dr. Bullowa discussed his pneumonia researches before the Second International Microbiological Congress in London.

With the advent of the sulfa drugs, he coordinated their use, in pneumonia, with that of specific sera, and had started work with penicillin as a means of fighting the resistant Friedlaender bacillus.

In 1919 he published a translation of Bechhold's "Colloids in Biology and Medicine." In 1937, the Oxford University Press published his book, "The Management of the Pneumonias"; and in 1939 there appeared his book, "The Specific Therapy of the Pneumonias." Apart from these, he published about 160 papers on a wide variety of scientific and medical subjects, including the influence of colloidal protection on milk, Roentgen-ray studies of bronchial function and practical applications of basal metabolism. He was elected to membership in the honorary societies, Alpha Omega Phi and Phi Beta Kappa.

Dr. Bullowa's selfless devotion to his patients exemplified the highest ideals of the medical profession. It is men of his mold that bring increased honor and respect to the professions they practice. He was a well-grounded and successful diagnostician, although he once jocularly remarked that, because of inherent difficulties and uncertainties, diagnosis is the art of shrewd guessing, the ability to discern the basic cause underlying the available evidence. Apart from his personal practice and research, he taught others his skill and his ideals.

JEROME ALEXANDER

RECENT DEATHS

DR. WILLIAM D. HENDERSON, physicist, director of the extension division of the University of Michigan, died on May 26 at the age of seventy-seven years.

DR. WILLIAM MASON GROSVENOR, consulting engineer of New York City, president of the W. M. Grosvenor Laboratories, Inc., died on May 30 at the age of seventy years.

DR. J. K. ROBERTS, physicist, fellow of Christ's College, Cambridge, died on April 25 at the age of forty-seven years.

A CORRESPONDENT writes: "The Rev. G. Birkmann, a retired Lutheran minister, died on May 17 at Giddings, Texas, in his ninetieth year. Any one doing research work with insects, birds and snails or other small organisms from the Gulf Coast of the United States is familiar with the name G Birkmann, Collector, after the name of original descriptions written by the early systematists who worked in the southern United States. This information is given for the benefit of those who desire to have a complete record of those men who made possible the wonderful collections from southeastern Texas."

SCIENTIFIC EVENTS

SCIENTIFIC RESEARCH AND DEVELOPMENT IN GREAT BRITAIN[1]

A STATEMENT of the existing Government organization has now been issued as a White Paper under the title "Scientific Research and Development" to provide a factual background for the discussion of the part which the government can play in this field after the war. After describing briefly the constitution and functions of the Development Commission and of the three Committees of the Privy Council for Scientific and Industrial Research, for Medical Research and for Agricultural Research, and the organizations working under them, the statement outlines the existing organization in each of those government departments which is faced with special scientific problems peculiar to its own field of activities and administers research and development organizations of its own or has scientific advisers on its staff.

A further section of the White Paper describes the provision made by the government for financial assistance to the universities for fundamental research, and the final section, on coordination and control organization, deals with the Scientific Advisory Committee of

[1] From Nature.

the War Cabinet and with the responsibilities of the Lord President of the council in relation to scientific research. Although the statement includes no account of the special wartime activities of the research councils or of the research and development organizations of the Service and Supply Departments or of the many establishments working under their direction, it provides a very convenient picture of the structure of the Government organization for research in handy reference form.

BOOKS IN TRANSLATION FOR AND FROM LATIN AMERICA

IMPORTANT books of this country, particularly in the fields of science, medicine and technology, will be made more readily available in Spanish and Portuguese translations for peoples of the other American republics as the result of a project to be conducted by Science Service, the non-profit scientific institution, as a part of the broad program of the Department of State for intellectual cooperation in the western hemisphere.

Spanish and Portuguese translations of American books, issued by publishers in the other American republics as well as by U. S. publishers, will receive financial aid under this project. Books originally published in Spanish and Portuguese will be made available in English in the United States under provisions for similar aid to U. S. publishers.

A grant-in-aid by the Department of State provides Science Service with funds to help to defray the costs of translations, to obtain and distribute copies of the translated books to libraries, institutions and other organizations, and to cooperate otherwise in making the literature of any one American republic available to other peoples on the two continents.

The purpose of this two-way translation program is "to overcome the barriers raised by difference of language by making available to the peoples of the other American republics the writings which represent the thought and the cultural and intellectual life of the United States, and making available to the people of the United States the writings which represent the thought and cultural and intellectual life of the peoples of the other American republics."

The present program supplements previous support given through other agencies to translations which were largely in the fields of literature, history, the humanities and the social sciences. The present program will include books in all fields, except elementary and secondary school text-books, although the accent will be upon scientific books.

Suggestions as to translations needed are being received from officials, scientists, educators, publishers and others in this country and the other American republics.

Trustees of Science Service are nominated by the National Academy of Sciences, the National Research Council and the American Association for the Advancement of Science. Its offices are at 1719 N St., N.W., Washington 6, D. C.

THE INSTRUMENT SOCIETY OF WASHINGTON

AT a meeting on May 24 more than two hundred scientists and engineers of Washington, D. C., formally organized the Instrument Society of Washington to ". . . increase the knowledge of its members in matters pertaining to the theory, design, development, manufacture and application of instruments and control devices in the fields of engineering and the sciences, and to . . . advance the art and science of measurement and control."

A constitution was adopted and the following officers were elected:

President: R. C. Darnell, War Department.
Vice-presidents: D. F. Windenburg, David W. Taylor Model Basin, and Colonel W. R. Blair, USA (Ret.).
Corresponding Secretary: W. A. Wildhack, National Bureau of Standards.
Recording Secretary: R. G. Quick, Weather Bureau.
Treasurer: Raymond Margary, University of Maryland.

An illustrated lecture on "Recording Instruments" was given by E. G. Howe, of the General Electric Company. The next meeting will be held on June 14, in the auditorium of the Interior Department.

This organization brings to fifteen the number of local instrument societies spontaneously organized throughout the country in the last few years. No formal action has yet been taken toward affiliation of the various groups, but it is expected that this will develop in the future.

THE INDUSTRIAL RESEARCH INSTITUTE

THE sixth annual meeting of the Industrial Research Institute, an affiliate of the National Research Council, was held in Pittsburgh on May 19 and 20. Eighty-five industrial research executives and their guests attended.

Dr. Harold K. Work, manager of research and development of the Jones and Laughlin Steel Corporation, Pittsburgh, was elected chairman for the ensuing year, and John M. McIlvain, administrative supervisor of the Research and Development Department of the Atlantic Refining Company, Philadelphia, was elected vice-chairman. Dr. Charles S. Venable, director of chemical research of the American Viscose Corporation, Marcus Hook, Pa., and Harry M. Williams, vice-president of the National Cash Register Company,

Dayton, Ohio, were elected members of the executive committee.

Dr. Edward R. Weidlein, director of the Mellon Institute of Industrial Research, Pittsburgh, was guest speaker at the dinner on Friday evening. He discussed the future of industrial research. Earlier in the day Maurice Holland, New York, founder of the institute, spoke on the place, influence and obligations of the institute in the national research structure.

Salary and patent problems were considered at length during the meeting. On Friday morning Mr. McIlvain discussed existing research salary conditions in industry and pointed out that these are one of the more serious causes of difficulty in retaining research personnel. In the afternoon the various methods of patent procedure used in the research organizations of member companies were discussed in detail at round table conferences. The session was conducted by Dr. R. C. Benner, research consultant of the Carborundum Company, Niagara Falls, N. Y.

Cooperative research during the war in the aircraft industry was the subject of a paper by Dr. Maurice Nelles, chief of the Industrial Processes Branch of the Office of Production Research and Development of the War Production Board, and staff assistant in research of the Lockheed Aircraft Corporation, Burbank, Calif.

The part which the manufacture of rockets, jet propulsion planes and gas turbines—wartime developments—will have in postwar industrial expansion was the subject of an address by G. Edward Pendray, assistant to the president of the Westinghouse Electric and Manufacturing Company, Pittsburgh. He discussed the technical aspects and historical development of these devices and the possibilities of their future development.

The autumn meeting of the institute will be held late in September.

THE WARRINGTON YORKE MEMORIAL FUND

COLONEL RICHARD P. STRONG, M.C., director of tropical medicine, Army Medical School, has sent to SCIENCE an appeal that he has received from Dr. R. M. Gordon, professor of entomology at the Liverpool School of Tropical Medicine, for subscriptions for the establishment of a Warrington Yorke Memorial Fund. It reads:

The late Professor Warrington Yorke was a product of the Liverpool School of Tropical Medicine and one of its most distinguished members. In addition to his jealous maintenance of the high standards set by earlier workers at the school, he earned for himself an international reputation in the world of medical science, and his outstanding original work on trypanosomiasis, blackwater fever, the nematode parasites and many other parasitic and tropical diseases has permanently enriched our knowledge of these subjects.

In the latter part of his career, so untimely cut short, Yorke's exceptional energy and ability were increasingly devoted to the elucidation of the mode of action and the therapeutic value of chemical compounds, especially in parasitic diseases. As a direct result of his pioneer work, new and more potent weapons were forged to combat a number of diseases, in particular leishmaniasis and trypanosomiasis. That these discoveries were of far more than academic interest has been proved by their increasingly wide employment; indeed, it may be said that Yorke's introduction of drugs of the diamidine series is rendering possible the mastery of kala-azar in those parts of the world where the disease is peculiarly resistant to the antimonial compounds.

At the time of his death further studies in chemotherapy had been initiated by him, and it was his avowed object to promote chemotherapeutic research in Great Britain to the front rank and firmly to establish Liverpool as one of its leading centers. To that end, he laid a sound and solid foundation on which to build, but, though he lived long enough to see the realization of his ambition begun, he did not see it consolidated.

The Council of the Liverpool School of Tropical Medicine feels that a fitting memorial to this remarkable man would be to place on a firm financial basis the recently created Chemotherapeutic Research Department, where the work which he inaugurated will be continued in association with his name. To this end a Warrington Yorke Memorial Fund has been opened, and the council believes that Yorke's many colleagues, friends, past students and others who have benefited by the great advances which he helped to make in tropical medicine and hygiene during his forty years of service will wish to be associated with this memorial; from such the council would welcome subscriptions, however small, which should be addressed to: The Honorary Treasurer, Liverpool School of Tropical Medicine, The Chamber of Commerce, 1, Old Hall Street, Liverpool.

SCIENTIFIC NOTES AND NEWS

THE Elbert H. Gary, Memorial Medal of the American Iron and Steel Institute was presented at a meeting of the institute on May 25 to Quincy Bent, vice-president of the Bethlehem Steel Company, in

recognition of his "outstanding leadership in steel production and contribution to the development of alloy steels."

DR. EDWIN H. ARMSTRONG, professor of electrical engineering at Columbia University and inventor of frequency modulation in radio reception, has been awarded by the War Department the certificate of appreciation of the first chief signal officer in recognition of "a notable contribution to the war effort when he waived all royalties on the use of seventeen of his patents covering frequency modulation radio apparatus purchased by the War Department for military purposes."

DR. J. C. GEIGER, director of public health of the City and County of San Francisco, has been granted by the Government of Ecuador the decoration "Al Merito" with the following citation: "For distinguished service, for noteworthy and indomitable leadership in the advancement of public health in the Americas."

A COPERNICAN Award has been presented by the Kosciuszko Foundation, New York City, to Dr. Frederick C. Leonard, associate professor of astronomy at the Lick Observatory of the University of California, in recognition of his "effective cooperation with the foundation in the observance of the Copernican Quadricentennial."

DR. HARRY BATEMAN, professor of mathematical physics and aeronautics at the California Institute of Technology, and Dr. W. M. Whyburn, professor of mathematics and chairman of the department at the University of California at Los Angeles, have been elected corresponding members of the Academia Nacional de Ciencias Exactas, Fisicas y Naturales de Lima.

AT the invitation of the Cuban Government and Dr. Alberto Recio, the Minister of Health, Brigadier General James Stevens Simmons, chief of the Preventive Medicine Service, Office of the Surgeon General, U. S. Army, visited Havana on May 17, and took part in the dedication of the new National Institute of Health. During the ceremonies President Batista decorated General Simmons with the Medal of the Carlos J. Finlay National Order of Merit in the grade of *Gran Official*. The President also sent by General Simmons to Major General Norman T. Kirk, Surgeon General of the Army, a certificate conferring the Carlos J. Finlay Order of Merit in the grade of *Gran Cruz* on the former American Yellow Fever Commission for its fundamental experimental work in Cuba on the etiology and transmission of yellow fever under the leadership of Major Walter Reed. The certificate will be preserved in the Army Medical Library in Washington.

THE honorary degree of doctor of science has been conferred by the Ohio State University on Dr. Thomas Midgley, Jr., president of the Ethyl Corporation and president of the American Chemical Society, in recognition of his achievements in fuel research.

THE honorary degree of doctor of science was conferred on May 29 by Virginia State College on Lloyd A. Hall, chief chemist for the Griffith Laboratories, Chicago, in recognition of "his many years of outstanding work in, and his contribution to, food chemistry."

DR. JOHN ALEXANDER, professor of surgery of the Medical School of the University of Michigan, delivered on May 18 the Henry Russel Lecture for 1944 given by the member of the faculty who had attained "the highest distinction in the field of scholarship." His lecture was entitled "Developments in Thoracic Surgery." Dr. Frederick K. Sparrow, Jr., assistant professor of botany, received the Russel Award as the junior member of the faculty whose achievements in scholarly activities and whose promise for the future seemed most to merit the appointment.

THE Clubes Cientificos de Mexico held a special session on May 3 in the Theater of the Palacio de Bellas Artes upon the occasion of the visit to Mexico City of Watson Davis, director of Science Service and of the Science Clubs of America, with which the Mexican science clubs are affiliated. The principal address was by Dr. Manuel Sandoval Vallarta, director of the National Polytechnic Institute of Mexico, while other speakers were Ing. D. Salvador Magana, organizer of the science clubs at the Polytechnic Institute; Gustavo R. Cota, and Professor Agustin Aragon Leiva, head of the Science Service Bureau in Mexico.

AN informal reception was given on May 28 for four members of the faculty who will retire on June 30 from the College of Science, Literature and the Arts of the University of Minnesota. They were Dr. W. H. Emmons, head of the department of geology and director of the Minnesota Geological Survey; Dr. L. Miller, professor of physics; Dr. C. O. Rosendahl, head of the department of botany, and Dr. C. R. Stauffer, professor of paleontology. Approximately two hundred associates, former students and friends were in attendance.

DR. FELIX BERNSTEIN, professor of biometry at New York University, has been appointed professor emeritus.

DR. FREDERIC PALMER, since 1916 professor of physics at Haverford College, will retire from active teaching at the close of the academic year.

THE retirement is announced of Dr. Charles C.

Johnson, professor of pharmacology and physiology at the School of Medicine of the University of Utah.

AT Columbia University, Dr. A. Irving Hallowell, chairman of the department of anthropology of the University of Pennsylvania, has been appointed visiting professor of anthropology; Dr. Henry E. Garrett has been appointed head of the department of psychology, and Dr. Thomas T. Read, head of the department of mining and metallurgy.

DR. RUSSELL SPURGEON POOR, professor of geology and head of the department at Birmingham-Southern College, has been appointed dean of graduate studies and director of the Research Council of the Alabama Polytechnic Institute.

DR. H. HOUSTON MERRITT, associate professor of neurology at the Harvard Medical School and visiting neurologist at the Boston City Hospital, has been appointed professor of clinical neurology in the College of Physicians and Surgeons, Columbia University, and chief of the Division of Neuropsychiatry of Montefiore Hospital. He will succeed Dr. S. Philip Goodhart, who is retiring after serving for thirty-one years. Dr. Merritt will be in charge of the investigative and clinical work of the division of neuropsychiatry of the hospital. Dr. Goodhart has been made consultant in the division of neuropsychiatry.

K. L. TURK, professor of dairy husbandry and head of the department at the University of Maryland, has resigned to become professor of animal husbandry in Cornell University.

DR. F. W. FROMM has resigned as professor of chemistry at the Polytechnic Institute of Puerto Rico at San Germán, in order to work in the same capacity at the College of the Sacred Heart, at Santurce, Puerto Rico.

IN a recent issue of SCIENCE, Dr. R. A. Baker, professor of chemistry in charge of the department of the commerce center of the College of the City of New York, was referred to as head of the department of chemistry. This is incorrect. Dr. William L. Prager is chairman of the department.

SIR JOHN FRASER, Bart., regius professor of clinical surgery at the University of Edinburgh, has been appointed to succeed Sir Thomas Holland as principal of the University of Edinburgh.

DR. GEORGE C. DECKER, research and extension associate professor of entomology in the Iowa State College, has been appointed entomologist of the Illinois Experiment Station and of the Illinois State Natural History Survey.

DR. ERNST MAYR, of the department of birds of the American Museum of Natural History, has been promoted by the trustees from associate curator to curator of the Whitney-Rothschild Collections, in recognition of his "ornithological scholarship and his constructive service to the department of birds."

MAJOR JOSEPH B. FICKLEN, III, engineer of the U. S. Public Health Service, has joined the Industrial Hygiene Division of the Department of County Health of Los Angeles.

DR. HARVEY A. ZINSZER, since 1929 head of the department of physics and astronomy at the Kansas State College at Fort Hays, has been granted indefinite leave of absence to accept a war defense position in the Cruft Laboratory of Harvard University.

DR. A. G. PLAKIDAS, plant pathologist for the Louisiana Agricultural Experiment Station at Baton Rouge, has been granted leave of absence to serve with the United Nations Relief and Rehabilitation Administration as district agricultural officer with the Balkan Mission overseas.

THE first Richard H. Jaffé Lecture of the Institute of Medicine of Chicago, established in memory of Dr. Jaffé, pathologist of Cook County Hospital, who died in 1937, will be delivered on June 23 at the Palmer House by Dr. William F. Petersen, chairman of the Board of Governors of the institute. He will speak on "Organic Variability and Heart Disease."

SIR JACK DRUMMOND, F.R.S., gave on June 2 the Friday evening discourse at the Royal Institution of Great Britain, London. He spoke on the Hot Springs Conference and its bearing on nutrition in Great Britain.

THE American Society of Zoologists, in conjunction with Section F of the American Association for the Advancement of Science and in association with other biological societies, will hold its annual meeting for 1944 in Cleveland, Ohio, on Tuesday, Wednesday and Thursday, September 12, 13 and 14. The deadline for the receipt of titles and abstracts by the secretary is July 15. The preliminary announcement and call for papers will be issued by the secretary, Dr. L. V. Domm, the University of Chicago, in the near future.

THE fifty-eighth annual convention of the Association of Land-Grant Colleges and Universities will be held in Chicago from October 24 to 26. Preconvention sessions are planned from October 21 to 23.

A MEETING of the Aviation Division of the American Society of Mechanical Engineers was held from June 5 to 8 at the University of California at Los Angeles, where it is planned to establish a College of Aeronautical Engineering.

A SPECIAL meeting of the American Shore and Beach Preservation Association, under the presidency

of J. Spencer Smith, president of the New Jersey Board of Commerce and Navigation, met in Chicago on May 31 and June 1. This was the first national conference on coastal erosion problems and allied subjects held since the association suspended its regular sessions for the duration of the war. The Beach Erosion Board of the Corps of Engineers of the United States Army held a meeting concurrently with the conference of the association.

By the will of Dr. Oscar M. Stewart, emeritus professor of physics at the University of Missouri, his estate, the estimated value of which is in the neighborhood of $100,000, is bequeathed to the department of physics, "the net income to be used for some educational or scientific purpose connected with the department."

The *Experiment Station Record* reports that the Inter-American Institute of Agricultural Sciences has now acquired a permanent status through the ratification of the convention for its establishment by eight republics—the United States, Costa Rica, Cuba, Ecuador, Nicaragua, Panama, Honduras and the Dominican Republic. A permanent faculty is being selected, and construction is proceeding in the building program at Turrialba, Costa Rica. A substation for the development of high-yielding and disease-resisting rubber trees has also been opened in Panama.

The British Mycological Society, according to *Nature,* is making a collection of surplus reprints and pamphlets on mycology and plant diseases for distribution after the war to libraries and centers of research at home and abroad which have suffered loss or damage. Authors are invited to send reprints of their own published work and any other reprints or pamphlets which they can spare to G. C. Ainsworth, secretary of the British Mycological Society, Imperial Mycological Institute, Ferry Lane, Kew, Surrey.

It is reported in *Nature* that the Royal Society of Edinburgh has been made the residuary legatee of the estate of Robert Cormack, of Edinburgh, who died on August 13, 1942. The society is directed to administer this bequest for the purpose of promoting astronomical knowledge and research in Scotland, so far as practicable, on the lines of a memorandum prepared in 1931 by the late Professor R. A. Sampson, Astronomer Royal for Scotland. The council, on behalf of the Royal Society of Edinburgh, has accepted the bequest, which represents an amount somewhat over £30,000; and, after careful consideration, has approved a general scheme for the administration of the trust, which will include: (*a*) research fellowships to be awarded on suitable conditions to students engaged on research in Scottish observatories and to students or graduates of Scottish universities desirous of engaging in research in foreign or Dominion observatories; (*b*) the publication of the results of such research; (*c*) lectures to be delivered in suitable centers by eminent foreign or Dominion astronomers; (*d*) grants in aid of the purchase of special equipment for use in Scottish universities or observatories in research work; (*e*) lectures and demonstrations of a more popular character under the auspices of the Scottish educational institutions. A large part of this scheme will not be developed during the war.

DISCUSSION

NOTE ON STABILITY OF INCIDENCE OF THE "COMMON COLD"

In one of the best statistical analyses upon data assembled under good control which has been offered for discussing stability of resistance to the common cold, Gafafer and Doull[1] found that the hypothesis that the colds of their samples were distributed by chance was not improbable. Their fundamental technique was that of showing that in each year with each sample the distribution of the number of colds was according to the point-binomial or law of small numbers. They found that the numbers of colds suffered by the same individuals in different years were correlated to a small extent in a variety of groups of persons. If we should calculate the correlation coefficients for the three pairs of years for the 111 persons under continuous observation for the three years (Table 5, p. 720) we should find $r = .44$, .38, .35, each of which is alone significant. This, as they must have known, was in itself some evidence that the distribution of the colds was not quite by chance, even though the distributions were well fitted by the law of small numbers.

[1] W. M. Gafafer and J. A. Doull, *Amer. Jour. Hygiene,* 18: 712–726, 1933, and Science, 78: 314–315, 1933.

There are indeed some limitations to the use of the law of small numbers as evidence of chance behavior; of these one is the difficulty of determining whether the law is satisfactorily fitted. Consider, for example, the distribution of colds of each of the 111 persons for the whole three years, the numbers varying from 0 to 21. The mean of the distribution is 8.315 and the variance is 13.00, which indicates a hypernormal distribution with too much dispersion about the mean as would be the case if some were resistant and others susceptible to colds. Now $\sigma = 3.61$ as computed from the distribution and $\sigma = 2.88$ as estimated from the

square root of the mean on the assumption of the law of small numbers are significantly different[2] (diff. = .73 ± .19) if we make a rough estimate throwing all the variability on to the observed value of σ. On the other hand, for the three distributions for each of the three years, we have for the means and variances $m = 3.00$, $\sigma^2 = 2.68$; $m = 2.83$, $\sigma^2 = 2.70$; $m = 2.49$, $\sigma^2 = 1.93$, which indicates that in each year the distribution is subnormal. Even if these three distributions be thrown together despite the inter-year differences of m, the resulting distribution is subnormal, with $m = 2.77$, $\sigma^2 = 2.48$. Thus there is evidence that the variation is less than that due to chance, as well as evidence that the variation is greater than that due to chance, entirely apart from the evidence of the correlations cited above.

At the time Gafafer and Doull were writing (1933) the analysis of variance had hardly got into the literature.[3] It would appear that this method of analysis might be one very appropriate to the discussion of their exceptionally good data. If we consider that the number of colds n_{ij} of the ith person in the jth year ($i = 1, 2, \ldots, 111$; $j = 1, 2, 3$) consists of one part appropriate to the individual, one appropriate to the year and a residual independent of both, Table 1 may be constructed:

TABLE 1

	Sum of squares	Degrees of freedom	Mean square
(1) Between year means ..	15.2	2	7.60
(2) Between person means .	480.7	110	4.37
(3) Residual fluctuations ..	330.8	220	1.50
Total $S(n_{ij}-n)^2$	826.7	332	.

The values of the mean squares indicate that the variation from year to year ($\sigma_y = 2.8$), poorly established because of the small number of degrees of freedom, is considerably larger than the variation ($\sigma_p = 2.1$) between persons; but as the ratio 7.60 : 4.37 of the variances is not significant, one may not claim the difference as meaningful.

Compared with the residual variance 1.50, both that between years and that between persons is significant, for the former at around the 1 per cent. level and the latter at well below that level. The evidence is therefore corroborative of that offered by the inter-year correlation coefficients to the effect that there is significant evidence that the distribution of colds was not by chance but was affected by an inter-individual variation of resistance to the common cold or by some systematic influence which simulated it, such as a higher exposure rate among some than among others of the persons under observation.

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[2] Although the distribution seems to be very significantly hypernormal, the chi-square test applied to it gives a variety of results from $P = .05$ to $P = .50$, according to the manner of grouping, and fails to indicate in any clear manner that the fit is significantly bad.

[3] R. A. Fisher, "Statistical Methods for Research Workers," 1925, and subsequent editions, Chapter VII; G. W. Snedecor, "Calculation and Interpretation of Analysis of Variance and Covariance," 1934; G. U. Yule and M. G. Kendall, "An Introduction to the Theory of Statistics," 1937, pp. 444–449. Reference should also be made to two articles by J. O. Irwin, *Jour. Roy. Stat. Soc.*, London, pt. II, 1931, 284–300, *ibid.*, Supplement, 1: 1934, 236–251.

RESUSCITATION APPARATUS

THE recent controversy between the late Professor Yandell Henderson and Council on Physical Therapy of the American Medical Association contains a most unhappy and serious implication. It would appear, from the matter presented, that the recovery of the asphyxiated patient turns exclusively upon the operation of mechanical gadgets designed to meet and overcome all conditions accompanying the unconscious state. If the patient recovers, he has been saved; if he dies, he was beyond all hope of rescue.

This implication would seem to confirm the layman's everyday observation, the patient with a persistent headache, an abdominal pain or a fracture is a serious medical problem. He demands, and if it is available he receives, the best medical care obtainable. But should unconscious or respiratory failure supervene, his condition is suddenly simplified to a point where the police, the fire or the consolidated gas squad is all the assistance required. If the squad can bring or borrow an inhalator or a resuscitator, everything is perfect. Or—

If a child inhales a peanut or a pin, he is hustled off to the hospital and receives every advantage of the bronchoscopic clinic. Should he be so unfortunate as to inhale something larger, a marble or a chunk of meat, he is no longer in need of medical help. Everything will be solved if the suck and blow apparatus used last week in the stevedore down the street can be secured.

Asphyxia-conscious physicians are well aware of the phenomena which occur between the onset of unconsciousness and the death of the patient. They are prepared to control and to direct these phenomena. Treatment must necessarily vary with the stage of asphyxia treated. The depressed, the spastic and the flaccid patient each requires a different approach. It is frequently fatal to attempt to fit the desperately ill patient into treatment suited to the patient who is merely depressed. It would seem as reasonable and in many cases safer to attempt to employ a mechanical robot for a brain operation, on the basis of electrical potentials, than it is to attempt to subordinate respiratory rate and rhythm in a patient about to die.

Controversy over mechanical gadgets plays directly

into the hands of commercial interests, without contributing to the problem at issue. It is most regrettable that medical leaders and respected medical groups should be betrayed into a position where their directive influence deteriorates to the level of the pros and cons of a mechanical gadget. Yandell Henderson was perfectly correct when he said that resuscitators killed thousands of patients—not as bullets do directly, but by providing a gesture and alibi for the correct treatment required.

Instead of such unfortunate emphasis, therefore, why not put more emphasis on the problem requiring treatment? While it is granted that this would be out of place in clinical disease involving biochemical reactions, extending over a period of time, it is quite in order in conditions in which mechanical problems are involved, where a life may be saved or lost in a few minutes.

Radio, aerodynamics and many other skills are quickly picked up by lay men and women. Why not popularize the mechanics of asphyxiation? Not as heretofore by a frozen drawing of the respiration, but as the very much alive mechanism which depends upon reflexes and normal muscles for protection and which presents, progressively, a totally different problem, when asphyxia has put these protective factors out of commission and blocked the airway with blood, vomitus or other foreign matter. Any one with ordinary mechanical sense could promptly improvise relief for these situations once they are understood. He would soon know as well or better than a salesman whether or not a given resuscitator was of much use to him. Why not debunk the mystery of the mechanics of asphyxia?

The informed layman will have little difficulty in appreciating that an air line which is blocked can not function, that an obstruction can sometimes be bypassed more easily than it can be overcome. He will understand how gas pressure in the nose and mouth can blow vomitus or blood which may be in it into the windpipe. He can observe a change in the color of the patient as well as any one, if he is instructed to look for it.

The entire approach to the devastating problem of asphyxia should be revamped. What is treated should become the important thing. Thousands will continue to die until the patient and not the apparatus becomes the issue.

It is respectfully suggested that the Council on Physical Therapy or the Council on Medical Education issue a statement covering the presently accepted views relating to the pathological physiology of asphyxia, *i.e.*, the stages of asphyxia, the signs which accompany each of these stages, the indications for the correct treatment of each stage, the simplest means by which these indications may be met. A patient about to die is entitled to the maximum effort in rescue; after this consideration the late effects of such treatment are to be considered and measured. The indications for treatment are clearly indicated in the pathology of each stage; any experienced pneumatologist (gas therapist) is familiar with the care of the unconscious patient.

When the needs of the patient are clearly stated by a recognized authority and the simplest means of meeting these needs are described, resuscitation equipment will automatically fall into line in response to the law of supplying what the informed public demands.

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WITH interest I read the reply of the Council on Physical Therapy of the American Medical Association to the late Yandell Henderson's attack on the Pulmotor and its successors. It is possible that this article, as it appeared in SCIENCE, December 24, 1943, was the old warrior's last use of his mighty battle-axe —and I honor it.

A controversy between advocates of what Henderson terms "suck and blow" on one side and advocates of insufflation on the other side is only of recent date, but the actual fight against suction to the lungs has been going on for thirty years. A sharp battle line could be drawn between Roth-Draeger, the German originators of the Pulmotor, Coryllos, the lone proponent, and now the council on one side and the three opponents of negative pressure, Meltzer, Henderson and Flagg, on the other side. During this thirty-year period "suck and blow" was several times knocked out but was always revived. At present the survival of the fittest seems indefinitely dated ahead.

Considering that Yandell Henderson spent practically half of his lifetime in research on the subject of resuscitation and its kindred, and that his devotion to the study of the physiology of respiration was truly scientific, the reply of the council doesn't seem to me a scientific repartee. The council argues on the principle of "the proof of the pudding is in the eating" when asserting that, statistically, resuscitation apparatus applying positive and negative pressure has never killed a patient nor injured respiratory organs. On that basis the council is fully justified in considering the principle as workable and in accepting the apparatus in question, but as an argument against Henderson's assertions it is far from the point.

Only in one instance the council uses a basic figure. It is the reference of a safe positive pressure to the lungs of 13 mm. Hg., and this is conspicuously a factor to which Yandell Henderson paid less attention than to other factors. What he was mostly concerned with

when warning of the dangers of the "suck and blow" resuscitators was the factor of negative pressure to the lungs and the impossibility to synchronize with the patient's respiration.

The first warnings on these features appeared in the report of the Bureau of Mines in 1914.[1] It was the report of the committee on resuscitation that "killed the Pulmotor," and Henderson from then on stood up for the findings then established. It would be of interest at this time to know whether the Bureau of Mines had any reason to alter their opinion since then and whether eventually they give the principle of "suck and blow" a right to be.

One of the committee of 1914 was the late Dr. S. J. Meltzer, of the Rockefeller Institute, and it was his disbelief in the safety of negative pressure to the lungs and his belief in the necessity to synchronize which led him to develop the simple, safe and inconspicuous method of resuscitation known as the Meltzer method. It is on the principle of pharyngeal insufflation with a limited safe pressure, leaving deflation to the natural contraction of the chest wall, first published in the *Journal* of the American Medical Association, May 10, 1913, and later adopted by Henderson and Haggard, by the Society for the Prevention of Asphyxial Death, by many specialists on respiration and, with modifications, used by many institutions all over the world.

Naturally an apparatus built on the principle of insufflation only is not as impressive as an apparatus built on the principle of positive and negative pressure. It is human nature, without sufficient thought, to be impressed by the performance of a device apparently so similar to the functions of human respiration. The fact that human respiration is just the reverse, that it is done with negative pressure at inspiration and positive pressure at expiration, while the pumping apparatus applies positive pressure at inspiration and negative pressure at expiration is not considered or I will say not even recognized.

With all due respect to the council, I still believe in Yandell Henderson.

Richard Foregger

New York, N. Y.

[1] U. S. Technical Paper No. 77.

A NEW PRESIDENT FOR THE HARVARD APPARATUS COMPANY, INC.

In 1898, three vital changes in the teaching of physiology were proposed:[1]

(1) Since physiology consists not of words but of basic experiments, the student must every day make such experiments for himself. (2) Experiments too difficult or time-consuming shall be dealt with by a separate committee of three students, which committee shall report to the class the account given by the discoverer; and the committee shall show to their mates the original source. (3) There shall be no more lectures in the old sense. The professor and his staff shall discuss with the class the student's experiments immediately after he has made them; and they shall discuss very difficult experiments only after the students have read the discoverer's own statement of the discovery.

Such instruction, based on experimentation, requires large stores of apparatus, accurate but inexpensive.

So the Harvard Apparatus Company was launched. New instruments were invented; old instruments were redesigned for "quantity production."

Forty-five years have now passed. The company has all this time been in the hands of its founder and his admirable associates.

The founder believes it is time to have a new president.

In our search for the new president we have been fortunate indeed. We have found a man of uncommon ability—a man who has earned the profound respect of our profession and our very real affection.

Dr. A. J. Carlson will be president of the Harvard Apparatus Company, Incorporated, beginning on June 1, 1944.

W. T. Porter

Dover, Mass.

[1] See footnote to page 2 of a paper on "The Teaching of Physiology," *Philadelphia Medical Journal*, September 1, 1900.

GENERAL BIOLOGY

The distinction between the "biological sciences" and the "physical sciences" emphasized by Professor Shull in a recent number of Science,[1] is a very excellent one. Since it raises the biological sciences to a level where each is commensurate with the exact ones, "physics, chemistry, mathematics, meteorology, geology, astronomy, etc.," the distinction has a most attractive sound to teachers and workers in the less exact, biological subjects. Carried to its logical conclusion, colleges and universities should be reorganized, either by amalgamating the physical sciences into one department or by elevating zoology and botany, perhaps also physiology, genetics, microbiology, ecology, etc., each to full departmental importance. Psychology and anthropology, already full departments in many institutions, might be considered parts of this group.

In the first alternative, it would undoubtedly be necessary to "concoct" a "hodge-podge" course as an "extraction of all" the physical sciences, presenting it as an introduction to these subjects. Since Professor Shull deplores "general biology," so too he would unquestionably object to such a course as "gen-

[1] Science, n.s., 99: 199, 1944.

eral physical science." The second alternative has interesting possibilities. Each of the new departments would be sure to offer a "general" course, each bidding for student election on the basis of being the most outstanding for some particular reason. Students not planning to major in the sciences are usually required to take toward their "liberal" education at least one course in the physical sciences, and one laboratory course in the biological sciences. Under the revised arrangement, such a student would satisfy the spirit and letter of the requirements by taking one specialized course in each—say "general mathematics" and "general physiology." In the number of class hours available, could such a student be given the insight into the biological sciences now provided in a good general biology course? Could the "insight" be provided without adding to the total of required courses? Is the "insight" worth including in a liberal arts education? Why else does the requirement exist?

Freed of any close association through offering a course in "general biology" the preference for subject-matter shown by teachers and workers tends to draw them apart. The multiplicity of biological societies and journals is a good example of this tendency. But when a botanist, a zoologist, a physiologist, etc., must work together in presenting a "general biology" course, each acts as a check on the others. The botanist does not insert specialized information on neck canal cells, nor the zoologist the terminology of homologous segments in the crustacean appendage, nor the physiologist the logarithmic relationship between this and that, delectable as these items may be. The others object. In consequence the student is given an introduction to most of the branches of the biological sciences, with few of the technical details. Borderline subjects are mentioned in relation to the different aspects of the field. Biochemistry, biophysics, biometry, biogeography, bio-ecology, etc., form unifying bonds to connect the biological sciences with the physical sciences and with each other.

Perhaps a course in "general physical science" is an excellent suggestion. If the mathematics staff, the physics faculty, the chemistry group, etc., were to sit down together and each agree on what the other offered, each trying to get the other to orient the subject-matter into some understandable relationship, would the product perhaps give a better "insight" into the physical sciences than can be gained from one course in "general physics" or one in "general chemistry?" Perhaps such a group might be led to include not only some physical chemistry, etc., but also to show in their course how much relationship there is between the physical and the biological sciences.

As a biologist who found considerable stimulation to thought in pre-war collaboration with colleagues while presenting a share in a general biology course, and as a war research investigator needing familiarity with all the biological and physical sciences, the writer can sympathize with Professor Shull, yet at the same time feel that a closer, rather than a looser coordination between these sciences is particularly desirable in both the teaching and research fields.

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SCIENTIFIC BOOKS

CYTOCHEMISTRY

Frontiers in Cytochemistry. Vol. X, Biological Symposia. Edited by Professor NORMAN L. HOERR. 334 pp. Illustrated. Lancaster, Pa.: The Jaques Cattell Press.

THIS volume represents a series of lectures given at a symposium held at the University of Chicago in honor of Professor R. R. Bensley's seventy-fifth birthday. A paper by Dr. Bensley himself, on the chemistry of cytoplasm, aptly serves as a summary of the principal contributions of the volume.

For the most part the approach of biochemists to the problem of describing the metabolic activities of living material has involved the use of techniques which disregard the heterogeneity of the cell or of the tissue being studied. It is to be expected that the only enzyme reactions to survive this treatment would be those characterized either by an exceptional and persisting activity or by the resistance of their component parts to the deleterious influences involved in breaking up cell structure.

However, due largely to the influence of Professor Bensley, a group of investigators, for the most part men who are trained as cytologists, have begun to attack the problem of localizing within the individual cell particular parts of the enzyme reactions which we write now as descriptions of the over-all metabolic process. Perhaps many of the difficulties in our present over-all schemes will be resolved when we are able to draw a precise biochemical map of a cell.

At the present time it is possible to separate or characterize cell fractions constituting the nucleus, components of the nucleus, mitochondria, a submicroscopic lipo-protein complex, Nissl bodies in the case of nerve tissue and protein fractions which apparently constitute the structural elements of the cell. Cyto-

plasm is regarded therefore as containing a structural framework (largely of fibrous proteins) embracing a liquid menstruum containing soluble proteins, metabolites and inorganic salts, in which are embedded microscopic and submicroscopic particulates of highly complex composition. Both the chemical nature and the biochemical properties of these components vary widely.

Lazarow contributes a detailed discussion of the results of the investigation of these factors carried out in the Chicago laboratory within the past ten years. Along the same lines Claude describes the distribution of nucleoproteins among the various components of cytoplasm, and Gersh and Bodian report on a histochemical analysis of the changes occurring in motoneurons of the Rhesus monkey after root section. The methods used in separating various cellular components are treated at length in an article by Hoerr on the liver cell, while Beams describes the value and use of the ultracentrifuge in studies of this sort. Mirsky and Pollister discuss the fibrous nucleoproteins of the cell, and Schmitt, Hall and Jakus describe work in which they have examined various fibrous structures (collagen fibers, cilia, flagella, etc.) by use of the electron microscope. The soluble components of the cytoplasm are discussed in an article by Stern on such macromolecular particles in cytoplasm as ferritin, the complex containing cytochrome oxidase and the cytochromes, bacteriophage, etc. Articles by Chambers, Lowry and Scott are concerned primarily with the mineral constituents of protoplasm, Chambers describing experiments using his microdissection technique, Lowry describing investigations of the type initiated by Hastings, Eichelberger and their associates, while Scott reports studies of mineral distribution using the electron microscope. Striking differences in mineral content between intra-cellular and extra-cellular fluids have been recognized for some time. It becomes clear now that there are also intracellular localizations in mineral distribution. A review by Barron discussing various features of cellular respiration and a paper by Cowdry describing in detail the histological changes involved in the development of carcinomata in mice treated with methylcholanthrene complete the volume.

There can be no question of the importance of the objectives of the research discussed in this volume. Up to now the emphasis of workers in the field has been, as Professor Bensley rightly says, on "separating things before proceeding to their analysis." While knowledge as to the enzymic and chemical composition of these various cellular components is still slight, it is clear that biochemical schemes of intermediary metabolism must eventually be expressed in such terms and reconciled with such data.

As is the case with most books of this kind there are individual statements, ranging from matters of pure error to questions of proportion and opinion, with which one may disagree: for example, QO_2 (page 18) is not the customary symbol for respiratory quotient nor can one agree, for example, with the statement (page 56) that "oxaloacetate is used . . . as the phosphorylated compound in the formation of phosphopyruvate and synthesis of carbohydrate. It might also produce isocitrate"—when the first of these reactions is supported by no direct experimental data while the synthesis of isocitrate from oxaloacetate has been demonstrated beyond question. However, these are typical of the small flaws in what is, in general, an admirable effort.

The book has been edited by Professor Norman Hoerr and includes an appreciation of Dr. Bensley's work by E. V. Cowdry and an excellent portrait of Professor Bensley as a frontispiece. In format and typography it corresponds to the other volumes of the series.

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REPORTS

PRESENT TEACHING ACTIVITIES OF THE SCHOOL OF TROPICAL MEDICINE, IN COOPERATION WITH THE INSULAR DEPARTMENT OF HEALTH

IN 1926, at the inaugural ceremony that launched the School of Tropical Medicine as the first of its kind in the Americas, Dr. William Darrach, then dean of the College of Physicians and Surgeons of Columbia University, defined the objectives for which the new school had been founded as "the study and teaching of physical and mental ills as they occur in the tropics." These objectives were further defined in an early announcement of the school, thus: "The primary aim of the school is to give opportunity to study in a tropical environment the cause and prevention of that large group of ill-defined disorders known as tropical diseases and, at the same time, to observe the influence of tropical conditions on disease in general." Again in his inaugural address, when commenting on the advantages of Puerto Rico as the site for the School of Tropical Medicine, Dr. Darrach said, "The student will have the opportunity to see not only the dark side of conditions and their distressing effect on mankind but also the brighter side of what is being done to con-

trol them . . ." (referring to the work that was then being carried on by the Insular Department of Health).

Since its beginning, the School of Tropical Medicine strove to establish close relations with the Insular Department of Health—a strongly centralized organization that maintains active contact with every part of the island—and has cooperated in research projects and teaching activities, many times pooling mutual resources for the benefit of both. In 1940, the Insular Department of Health was able to expand its activities as a result of additional budgetary appropriations made possible by the inclusion of Puerto Rico under the provisions of Titles V and VI of the Federal Social Security Act The need for personnel trained in public health to direct the various new functions, in which the department was to participate, was immediately apparent. It was imperative to organize a teaching program as soon as possible and the School of Tropical Medicine, with its already well-developed departments of bacteriology, chemistry and nutrition, clinical medicine, dermatology, medical zoology and pathology, and its adjoining 50-bed hospital being operated as the school's chief teaching and research clinic, was the logical place for setting up the necessary training schedules.

Therefore, with the financial assistance of the Insular Department of Health, a Department of Public Health was created in the School of Tropical Medicine. During the first year courses for health officers, public health nurses and laboratory assistants were offered as a preliminary step in developing this program of education. Two hundred individuals have enrolled since then. At the present time, and for the coming academic year 1944–1945, the Department of Public Health of the School of Tropical Medicine, in cooperation with the Insular Department of Health, is offering the following courses:

(*a*) *Master of Science in Public Health:* This course of study, which covers a full academic year, is designed to provide the student with an understanding of the basic principles of public health work in their practical as well as theoretical applications. The subject-matter and sequence of study is, in general, similar to that provided by universities of the United States and Europe, with the exception that here more emphasis is placed on problems incident to a tropical environment. The course is essentially a postgraduate one and open only to doctors in medicine.

(*b*) *Master in Sanitary Science:* This is a course planned to acquaint the students with the principles and practices of public health engineering adapted to tropical environments. Candidates for this course must be graduates in science or engineering. The course lasts one full year.

(*c*) *Certificate in Public Health Nursing:* This basic course in public health nursing covers a full academic year and is open to registered nurses with at least two months of field experience in public health work.

(*d*) *Certificate in Medical Technology:* This course was established to meet the pressing need for trained workers in public health and hospital laboratories. It is open only to graduates in science who show evidence of having approved courses in biology, chemistry and physics.

(*e*) *Short Courses for Sanitary Inspectors:* This is a short course designed to provide an understanding of certain elements of public health work to persons now engaged in, or intending to engage in, public health work.

In addition to the financial assistance rendered, the Insular Department of Health contributes to these courses by providing facilities for field work. It is possible to carry on field work anywhere on the island and in any of the various agencies of the government. It is routine for students to make the District Hospital or the Public Health Unit their headquarters for whatever work they have in mind. These various agencies are also open to members of the school and to visiting scientists for any research work they may care to undertake.

The courses thus offered by the school follow the general pattern utilized in similar continental schools, although they are adapted to meet the needs of tropical areas, especially those incident to Puerto Rico. Because of the many facilities available, these courses are made as objective as possible. The student spends a large portion of his time in the field, studying the problem first-hand and the application of method or methods best adapted to its solution. The Division of Health and Sanitation of the Office of the Coordinator of Inter-American Affairs is sending several students to the school, since it feels that the health problems of many of the Caribbean, Central and South American countries are likened in many ways to those found in Puerto Rico, with the added incentive that here the most up-to-date methods are applied towards their solution.

The teaching of tropical medicine has continued as heretofore, special emphasis being given to bedside teaching, teaching at the dispensary combined with practical epidemiology and field work.

In summarizing, it may be said that mutual benefits have been derived by this close association between the Insular Department of Health and the School of Tropical Medicine of the University of Puerto Rico. A unique opportunity is thus provided for the teaching of tropical medicine and public health, as well as for research in these fields.

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SPECIAL ARTICLES

THE DESTRUCTION OF COENZYME I AND COCARBOXYLASE IN SKELETAL AND CARDIAC MUSCLE AFTER DEATH

In the course of studies of coenzyme breakdown in heart muscle after experimental coronary ligation in dogs, the idea was entertained that the amount of coenzyme breakdown after one hour of death might be considered the maximum breakdown that could be expected in that length of time following any experimental procedure. In order to test this hypothesis, six dogs (previously on a standard diet of "Pard" dog food) were anesthetized with pentobarbital sodium, the chests were opened and the hearts removed. Immediately on removal of the heart, a sample of left ventricle and a similar sample of deltoid muscle were removed, heated in boiling water for five minutes, homogenized and subsequently analyzed for cocarboxylase and coenzyme I. One hour later a second sample of each tissue was removed and treated in a similar manner. The dog and excised heart were allowed to remain at room temperature during the hour. Coenzyme I was determined by the method of Axelrod and Elvehjem,[1] as modified by Greig.[2] Cocarboxylase was determined manometrically, using split carboxylase prepared as described by Green *et al.*[3]

The results of these analyses are submitted in Tables 1 and 2.

TABLE 1

COENZYME I IN γ/GM OF DRY MUSCLE

Exp. No.	Skeletal muscle control	Skeletal muscle 1 hr. post-mortem	Per cent. change	Heart muscle control	Heart muscle 1 hr. post-mortem	Per cent change
II 1.	2730	2650	− 2.9	3120	2150	− 30 9
II 2.	2430	3380	+ 28.1	3180	2540	− 20.1
II 3.	1649	0	− 100.0	881	155	− 82 5
II 4.	2640	2235	− 15.1	3920	2375	− 30 3
II 5.	924	783	− 15.3	642	826	+ 28.7
II 6.	1173	1725	+ 47.0	2955	2610	− 11.7
Average			− 9.7			− 25.9

One may be impressed by the surprising lack of destruction under these conditions. Instead of finding nearly complete breakdown of cocarboxylase and coenzyme I, in the case of cocarboxylase in skeletal muscle at least, there is frequently less breakdown than was found previously in shock.[4]

TABLE 2

COCARBOXYLASE IN γ/GM OF DRY MUSCLE

Exp. No	Skeletal muscle control	Skeletal muscle 1 hr. post-mortem	Per cent. change	Heart muscle control	Heart muscle 1 hr. post-mortem	Per cent. change
II 1	23.7	22.5	− 3.4	55.0	61.2	+ 10.1
II 2.	22.8	20.3	− 10.9	68.6	53.3	− 22.3
II 3.	28.3	18.8	− 33 6	63.9	55.0	− 13.9
II 4	21 1	14.2	− 32.7	48.6	35.4	− 27.1
II 5.	21.3	20.9	− 1.4	71.0	53.0	− 25.4
II 6.	18.4	20.4	+ 9.8	65.8	63.3	− 3.8
Average			− 12 0			− 13.7

By way of explanation, one may suggest that after death the breakdown products of the coenzymes are not removed from the tissue by the circulation, and consequently by their accumulation may serve to inhibit catabolic enzymes. This explanation may be supported by work showing that thiamin inhibits yeast cocarboxylase phosphatase[5] and that nicotinamide inhibits coenzyme I nucleotidase.[6]

WM. M. GOVIER

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WINSTON-SALEM, N. C.

[1] A. E. Axelrod and C. A. Elvehjem, *Jour. Biol. Chem.*, 131: 77, 1939.

[2] Margaret E. Greig, personal communication.

[3] D. E. Green, D. Herbert, V. Subrahmanyan, *Jour. Biol. Chem.*, 138: 327, 1941.

[4] Margaret E. Greig and Wm. M. Govier, *Jour. Pharmacol. and Exp. Therapy*, 79: 169, 1943.

[5] H. G. K. Westenbrink, D. A. vanDorp, M. Gruber, H. Veldman, *Enzymologia*, 9: 73, 1940.

[6] P. J. G. Mann and J. H. Quastel, *Biochem. Jour.*, 35: 502, 1941.

AN EXPERIMENTAL METHOD FOR EVALUATING BLOOD SUBSTITUTES

REPORT ON SALINE, PLASMA, POLYVINYL ALCOHOL AND ISINGLASS

THE following conditions are desirable in an experiment designed to evaluate substances which may be used for the intravenous treatment of traumatic shock:

(1) The group of animals which is used for the test should be as nearly homogeneous as possible.

(2) The trauma should be of the same degree in each animal and easy to apply. Complicating factors such as anesthesia and hemorrhage into the injured tissues should be reduced to a minimum.

(3) The injury should be highly fatal in the control animals but mild enough to allow a proportion of the treated animals to recover. Percentage survival is considered to be the best single index of the effectiveness of treatment.

(4) The experiments should be carried out with the animals kept at a constant environmental temperature.[1]

(5) If a large number of animals can be handled at one time, there are the obvious advantages of con-

[1] F. M. Allen, *Arch. Surg.*, 41: 155, 1939.

venience and of improving the conditions for regulating the comparison between the substances under test.

Using rats in which shock of the tourniquet type was produced by a slight adaptation of a technique described by Haist and Hamilton[2] we have found that most of these conditions can be met. The present report deals with rat plasma, 4 per cent. solutions in 0.85 per cent. saline of isinglass[3] and of polyvinyl alcohol (Type RH623 E. I. du Pont de Nemours and Company) and of 0.85 per cent. saline alone.

Ten 224–250 gm rats were used each day. Two served as controls while the remaining eight rats were divided into groups of two, each group receiving one of the solutions to be tested. A metal tourniquet which could be tightened to exert a constant pressure, was applied high on the thighs of both hind legs for five hours. Transfusion through a cannula in the right jugular vein was started forty-five minutes after release of the tourniquets. Ten cc of solution were injected into each rat at a rate of 2-2.1 cc per hour. Pentothal sodium (0.3 cc, 1 per cent. solution per 100 gm of rat given intraperitoneally) was given to permit cannulation. The anesthesia was light enough so that the effects wore off a few minutes after the cannulation was completed. Apart from this no anesthetic was used or was considered desirable for any reason throughout the experiment. Except for the 10 to 15 minutes used for the cannulation the animals were kept in thermostatically controlled warming cabinets at a temperature of 27–28° C.

The first 27 rats received unsterilized solutions. Thereafter the saline and isinglass solutions were autoclaved and the plasma and polyvinyl alcohol solution were passed through a Seitz filter. The plasma was prepared the same day as it was used from blood obtained by exsanguinating etherized rats through the carotid artery. About 10 units of heparin per cc of blood were used as an anticoagulant. The plasma was allowed to stand for several hours in the ice box and then centrifuged to remove any precipitate which had formed. The filtration was performed about two hours before the injection was started.

The results are set forth in Table 1.

TABLE 1

SURVIVAL RATES IN RATS TREATED FOR SHOCK

Substances tested	No. of animals	No survived	Per cent. survived	Average survival time of the remainder in hours
Plasma	20	5	25	12 (range 2–38)
Saline	20	8	40	14 (range 3–33)
Isinglass	20	5	25	14 (range 2–31)
Polyvinyl alcohol	20	13	65	10 (range 4–20)
Control	25	2	8	10 (range 2–23)

Rats living more than 48 hours after the shock was initiated are considered to have "survived."

The effectiveness of polyvinyl alcohol is striking. The preparation used in this work (RH 623) has an approximate viscosity in 4 per cent. aqueous solution of 5 centipoises at 20° C. The molecular size has not been accurately worked out. Using preparation RH 391, a polyvinyl alcohol with a viscosity of 55 centipoises under the same conditions and therefore with a different molecular size, Heuper *et al.*[4] report many undesirable side effects following its parenteral administration in experimental animals. Although the toxic effects of RH 623 may be similar to those of RH 391 this should not be assumed on the basis of the work with RH 391 alone. For this reason we have undertaken to determine the toxicity of RH 623 separately. At any rate the fact that RH 623 is so effective for the immediate treatment of shock, is most interesting.

The relatively low survival rate in the group receiving plasma is worthy of comment. In accord with the findings reported here Allen[1] and Rosenthal[5] have found saline more effective than homologous plasma or serum in treating tourniquet shock in rats and mice. On the other hand, Mylon, Winternitz and de Süto-Nagy[6] working with dogs in tourniquet shock, report a 10 per cent. recovery with saline and a 76 per cent. recovery with citrated plasma. In a recent paper Green[7] states that homologous plasma did not decrease significantly the mortality in rats in tourniquet shock. It is apparent that the rating of plasma in the treatment of tourniquet shock is not clearly established.

The author wishes to thank Warrant Officer (S.B.) J. Scattergood, R.C.N.V.R., for his technical assistance, and Lt. (S.B.) C. R. Cowan, R.C.N.V.R., for technical advice.

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ASSOCIATIVE DYNAMIC EFFECTS OF PROTEIN, CARBOHYDRATE AND FAT

IN spite of published evidence warranting a different understanding, a general belief still prevails

[2] R. E. Haist and J. Hamilton. In press (personal communication).

[3] Kindly supplied by Professor N. B. Taylor, department of physiology, University of Toronto.

[4] W. C. Heuper, J. W. Landsberg and L. C. Eskridge, *Jour. Pharm. and Exper. Therap.*, 70: 201, 1940.

[5] S. M. Rosenthal, *Pub. Health Rep.*, 58: 1429, 1943.

[6] E. Mylon, M. C. Winternitz and G. J. de Süto-Nagy, *Amer. Jour. Physiol.*, 139: 313, 1943.

[7] H. N. Green, *Lancet*, ii: 148, 1943.

that the specific dynamic effects of individual nutrients are significant with reference to normal, mixed diets and that the relatively high dynamic effect of protein dominates heat production in nutritive practice.

The facts in this relation are of special present importance because of the critical situation of nutrition throughout the world; because of a characteristic rôle of fat in connection with the utilization of nutritive energy; because of the need for fat in the manufacture of explosives; and because of the increased efficiency with which fat is "skimmed off" in manufacturing processes from which by-product feeding stuffs are derived.

Significant in this connection is a series of respiration experiments conducted with albino rats as subjects, in which were determined the specific dynamic effects of protein, carbohydrate and fat, singly and in the four possible combinations of these three kinds of nutriment; all such determinations being made in

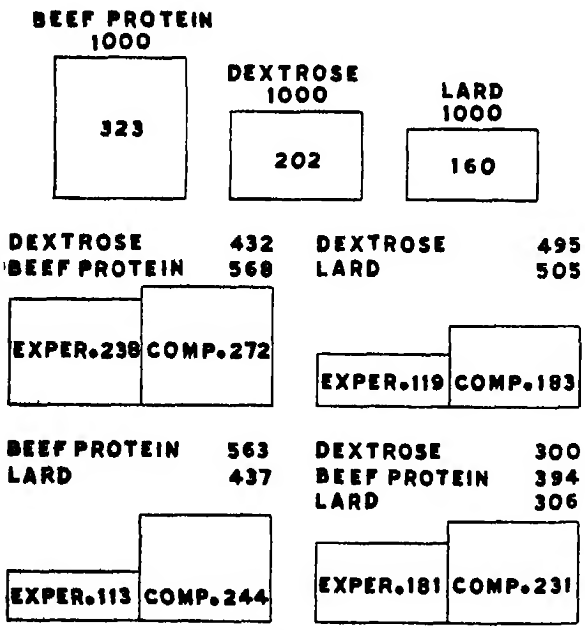

FIG. 1. Dynamic effects per thousand calories of gross energy of nutrients as affected by nutrient combination. Graph explained in text.

comparatively long-time experiments with the heat production from complete basal diets sufficient for maintenance as the base values.

Twelve rats of exactly the same age were used as the subjects of each determination, the dynamic effects being measured as the difference in heat production from the basal and the supplemented diets as observed for each dietary treatment during seven-hour experimental periods on two consecutive days, the observations on the supplemented diets being made seven days after those on the basal diets.

In Fig. 1 are presented values for the dynamic effects per 1,000 calories of gross energy of the individual nutritive supplements, and similar values for the four mixed supplements (1) as directly determined and (2) as computed from the values for their individual components.

The values above the rectangles represent in each case 1,000 calories of gross energy of the individual or of the combined nutrients, and the values inside the rectangles represent the dynamic effects of these substances fed as supplements to the basal diet.

The dynamic effects of the mixed supplements following the abbreviation, "Exper.," were as determined by experiment, while those following the abbreviation, "Comp.," were computed from the experimentally determined values for the individual components; the extent to which the determined were smaller than the computed values expressing the extent to which the association of nutrients resulted in decreased energy expense of utilization.

The separately determined dynamic effects of beef protein, dextrose and lard being 32 per cent., 20 per cent. and 16 per cent., respectively, of their gross energy values, the dynamic effects of the combination of dextrose and protein was 12.5 per cent. less, of dextrose, protein and lard 22 per cent. less, of dextrose and lard 35 per cent. less, and of protein and lard 54 per cent. less, than as computed from the dynamic effects of the individual nutrients.

Lard was much more potent than was beef protein in determining dynamic effects of nutrient mixtures. It conferred economy of utilization upon the nutrient combinations in which it was present.

The dynamic effects of diets, therefore, are not the additive dynamic effects of their components, and are not dominated by their protein contents; and inasmuch as there is no means of distributive assignment of the energy values of diets among their components, there are no significant standard dynamic effects of individual nutrients.

The results of this study suggest no special reason for decreasing the protein content of diets for hot weather, but rather that any desired decrease in dynamic effect because of hot weather should be accomplished by diminishing first the carbohydrate, second the protein and last the fat of the diet.

Also the results of this study imply that manufacturing processes which decrease the fat content of by-product feeds serve to lower the net energy value of the products not only through diminishing their gross energy but also by increasing the energy expense of their utilization.

That the protein contents of diets do not dominate

the heat increment is also shown by five series of experiments conducted at this laboratory (Forbes, *et al., Jour. Nutr.,* 10 (1935), 461; 15 (1938), 285; 18 (1939), 47; 20 (1940), 47), with mature as well as with growing rats as subjects, in which the heat production of animals receiving equicaloric diets differing in protein content decreased slightly in the order of the increase in protein.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE CHEMICAL CONTROL OF BERMUDA GRASS AND OF CROWFOOT GRASS

Sodium chlorate[1, 2] and cyanamide[3] have been suggested for an eradication of Bermuda grass (*Cynodon dactylon* Pers.). The compounds have been used with a varying degree of success.[4] Experiments with other herbicides seemed therefore indicated. As laboratory experiments[5] had shown that ammonium sulfamate has a high toxicity for Bermuda grass, tests at roadside plots and at a tennis court were started with this salt as well as with calcium thiocyanate, as this compound had been used successfully in the eradication of nut grass.[6]

Series of experiments were started in October, January, February, July, August and September, so as to compare the influence of the various seasons. 0.5 to 3 liters of the solution were sprinkled per square meter, which contained from 200 to 1,000 plants. The calcium thiocyanate has always been used as a solution 1.25 molar in CNS^-, while the concentration of the ammonium sulfamate varied from 0.5 to 2 molar. We are obliged to the American Cyanamide Company for the supply with calcium thiocyanate solution and to E. I. du Pont de Nemours and Company, Inc., for the ammonium sulfamate.

The control of the Bermuda grass has been completed within a week with as small an amount as 0.6 l. 1.25 m CNS^- per square meter if there was no rain in the first four days after the treatment. The plots remained free of weeds for three to six months after the treatment. However, the success of the treatment depends largely on the season. In dry weather the control was complete. If there was about 0.5 inch rain in the first few days after the application of the solution, complete control of the weed could still be reached by the use of 1 liter 1.25 m CNS^- per square meter. Heavier rains limited the eradication and could not be counteracted by higher doses of the herbicide. Also the length of time for which a complete control lasted was influenced by the rain, immigration of weeds, especially crowfoot grass (*Eleusine indica*) from neighboring plots occurred much quicker in the rainy than in dry season.

Ammonium sulfamate killed the Bermuda grass in doses of 0.6–1 liter of molar solution completely in the dry season. The control lasted from 3 to 5 months. Weaker solutions were only partially effective. The rain affected its action more than that of the calcium thiocyanate; 0.5 inch rain in the first 4 days already reduced the control to about 90 per cent., stronger rains made it rather incomplete.

Some of the plots treated with calcium thiocyanate contained also a large number of crowfoot grass (*Eleusine indica*). Ada Georgia[7] reports that carbolic acid can be used for its eradication, but otherwise little seems to be known about its chemical control. Its eradication by 1.25 molar CNS^- seemed much more difficult than that of Bermuda grass. 1 to 1.5 liter per square meter gave only a 50 to 80 per cent. control. The picture changed, however, when the treatment was preceded by a cutting of the grass. Then, 1 liter of 1.25 m CNS^- eradicated 90 to 100 per cent. of the grass within the first week, also heavy rains (more than 3 inches in the first 4 days) did not seriously interfere with the herbicidic action of the calcium thiocyanate.

Hence, it can be said that 1.25 m CNS^- or m ammonium sulfanate control Bermuda grass effectively if applied at the ratio of 0.6 to 1 liter per square meter in the dry season. 1.25 m CNS^- at the ratio of 1 liter per square meter will eradicate crowfoot grass only if the grass was previously cut.

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GIANT EARLY MAN FROM JAVA AND SOUTH CHINA[1]

By Dr. FRANZ WEIDENREICH

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JAVA, which stood in the focus of anthropologists fifty years ago when Eugène Dubois first announced the find of the "missing link," *Pithecanthropus erectus,* became a cynosure again when Dr. R. von Koenigswald, of the Geological Survey of Netherlands Indies, made a series of discoveries, each later one always more important than its predecessor. It began, in 1937, with the discovery of a large fragment of a lower jaw found in the Trinil beds of Sangiran. This jaw was much more complete than the one picked up by Dubois from the Trinil beds of Kedung Brubus, in 1891, and later attributed by this author to *Pithecanthropus.* Then followed the surprising discovery, in 1938, of a skull cap—fragmentary too—but much more complete than Dubois' Trinil skull which it resembles as one egg another in general form as well as in details. This specimen proved beyond the slightest doubt that *Pithecanthropus* is morphologically not a giant gibbon, and as such intermediate between ape and man, as Dubois insisted, but a true hominid very like the Peking man, *Sinanthropus pekinensis.* In 1939, von Koenigswald's native collector picked up an upper jaw from the same site from which the skull cap of 1938 had come. This jaw, almost complete, but slightly crushed, was the second surprise. It was in all dimensions larger than any known fossil or recent human jaw; there was a fairly wide gap between the canine and the incisor; the canine was not tusk-like but showed all the peculiarities of the *Sinan-*

[1] Read before the American Ethnological Society in New York, May 9, 1944. The war and its consequences prevented Dr. R. von Koenigswald from announcing the new discoveries referred to in this paper. Since Java is cut off and neither Dr. von Koenigswald nor the Geological Survey of Netherlands Indies are approachable, I asked the Board for the Netherlands Indies, Surinam and Curaçao, which represents the government of Netherlands Indies, for an official permit to publish the material, being sure of Dr. von Koenigswald's personal consent. Mr. G. H. C. Hart, the chairman of the board, kindly approved the publication.

thropus canines; the second molar was larger than the first and the third ones and, finally, the palate was smooth and not covered with rugosities. In other words, the jaw exhibited several very distinct simian features beside its general human appearance, a combination never observed before. Some weeks later the calvaria to which the jaw belonged was recovered. Although the entire frontal part is missing the rest is impressive enough. The brain case is considerably larger than that of the two *Pithecanthropus* skulls, not because of greater capacity but as the result of the extraordinary massiveness of the bones and the heaviness of the so-called superstructures, the enormous occipital protuberance and a peculiar sagittal crest which runs along the top of the skull.

So the new skull considerably differed from the two *Pithecanthropus* skulls found earlier. But as von Koenigswald and myself were still under the spell that all human remains gathered from the Trinil formation of Java must belong to the *Pithecanthropus* type, we declared the big, massive skull to be male and the two smaller and less massive ones to be females. This was all the easier as no other upper jaw and upper teeth of *Pithecanthropus* were known. But soon I felt a little less sure of this decision when von Koenigswald informed me several months later that a new fragment of a lower jaw had been recovered from the same locality, but obviously from a larger jaw than that of 1937. Unfortunately, this new jaw is very defective, in particular in the canine and premolar regions, so that it is quite impossible to determine the real nature of this specimen as long as nothing but a cast is available. However, one thing seems to be sure. If it is an anthropoid as it appears to be, then this anthropoid is not only much shorter snouted than any known anthropoid but also has some undoubtedly human-like features. If it is a hominid, then it has some simian features not encountered so far in hominids. However this may be, Java and Dr. von Koenigswald provided us, in 1941, with an additional and still more important find which follows the same line as already indicated by the previous ones, but is so unambiguous in its morphological character that it can help us without resorting, for the moment, to the ambiguous jaw of 1939.

This new and so far latest discovery, with which we were becoming acquainted just before the occupation of Java by the Japanese cut all ways of communication, is again the fragment of a lower jaw. It is undoubtedly a human jaw, but the features which render certain this identification reveal such an early state that they stamp this jaw as the most primitive human skeleton part ever found. However, this is not the only revolutionary disclosure. Not less momentous is the fact that this jaw exceeds by far in size, especially in thickness, all that is known of any fossil or recent human jaw, including the famous Heidelberg jaw. Contrarily to the latter, the teeth of the new jaw participate in this gigantism.

Von Koenigswald, recognizing at once the human character of the fragment and, of course, also its gigantic proportions, gave the type the name *Meganthropus palaeojavanicus*. So far we have no other word from von Koenigswald, but by labelling the specimen in this way he makes known that he considers the type represented by the jaw as a giant hominid different from *Pithecanthropus*. The new find not only introduces a completely new and unexpected form into our collection of fossil hominids, it also compels us to revise our view about the uniformity of the human fossils embedded in the volcanic ashes and sands of the Trinil formation of Central Java. As a first consequence of the new knowledge we have to scrutinize again the big skull of 1939 which we ranked as a male individual among the *Pithecanthropus group*. This skull is not a true giant form when compared with the proportion of the new jaw, for the *Meganthropus* jaw is much too large and massive for it. Yet compared with the two "female" skulls found earlier, the big skull already shows a clear tendency toward gigantism and as such appears intermediate between Dubois' *Pithecanthropus erectus* and von Koenigswald's *Meganthropus palaeojavanicus*. In order to emphasize this peculiar position I have proposed to call this intermediate type *Pithecanthropus robustus*.

When we make an inventory of all the lower or upper jaws of hominids recovered from the Trinil beds, we face the singular and certainly surprising fact that all four differ in size, the smallest being the so-called *Pithecanthropus erectus* of Kedung Brubus, the largest the *Meganthropus* jaw, while the lower jaw of 1937 and the upper jaw of *Pithecanthropus robustus* fit in between the two extremes, the former again a little smaller than the latter. As these differences in size go hand in hand with differences in morphological characteristics—the larger one is in general more primitive than the succeeding smaller one—it is obvious that we have before us a group of closely related types each derivable from the other in the sequence of their size.

Before we enter into a discussion of how this fits in with the scheme of phylogenetic evolution of man and the available geological data, we must refer to another discovery Dr. von Koenigswald has made, this time not in Java but in South China. Aware of the well-known fact that the drawers of Chinese apothecaries are places where you can count on gathering rare fossil teeth and bones, he used to hunt for these curios whenever he passed through China. He was

fortunate enough to secure three strange teeth in this way, between 1934 and 1939, each time in chemist's shops in Hong Kong. The first acquired tooth, rather considerably worn but still recognizable, was a right lower molar without roots, but of gigantic proportions. In the same drawers there were, among other teeth and bones, teeth of stegodon, tapir and orang-utang, most of them without roots, but with indication that they were gnawed off. Von Koenigswald determined the big molar to be the tooth of an anthropoid and called it *Gigantopithecus blacki*. However, von Koenigswald was unable to say more about this tooth, but it was evident to him that it has no close relationship to any of the known living or fossil anthropoids. The next tooth, acquired some years later, was an upper molar also without roots but much less worn; and the latest acquired was again a third lower molar but this time a left one and only very slightly worn. The posterior root was preserved, the anterior broken or gnawed off. The degree of wear proves that the two third molars had belonged to two different individuals. Thus, *Gigantopithecus* is represented so far by two or eventually three adult individuals. But the gist of the whole story, which arouses our foremost interest, is the fact that *Gigantopithecus* is not a giant ape, as von Koenigswald assumed, but a giant man and should, therefore, be called *"Gigantanthropus."* This follows beyond any doubt from the very characteristic pattern of the occlusal surface of the teeth, which differs fundamentally in the structure of the cusps from that of any known anthropoids but agrees even in the minutest details with the hominid pattern as shown by the molars of *Pithecanthropus, Sinanthropus* and even modern man. On the other hand, the form of the teeth, especially that of the third lower molar, and the condition of its root indicate that it has preserved a very primitive character, much more primitive than the known third molars of any fossil hominid. Therefore, we have the same combination which struck us in the human fossils of Java; namely, primitiveness together with gigantic proportions But in the case of *Gigantopithecus* the gigantism reaches a new climax. The volume of the crown of the third lower molar is about six times larger than the average crown of modern man; compared with the corresponding tooth of the gorilla, it is about twice as large.

In the case of the Javanese *Meganthropus* with a considerable part of the jaw preserved, we can risk computing the probable size of the skull and the body. If a gorilla is taken as standard size we shall not fail much in estimating that *Meganthropus* reached the size, stoutness and strength of a big male gorilla. Concerning *Gigantopithecus* we are more in the dark, because the lower and the upper molars are the only basis for calculation. Nevertheless, it seems safe to say that *Gigantopithecus* considerably exceeded *Meganthropus in size and robustness.*

The next question which arises is, of course, as to whether there is any evidence of connection between the giant hominids from Java and China, and, if so, what kind of connection exists. In spite of the deficiency of the material in both cases, and although we seemingly do not know more of the provenance of the *Gigantopithecus* teeth than the fact that they were gathered from drawers of a chemist's shop, we are surprisingly well off if we follow the traces provided by the conditions of the teeth. Teeth of stegodon, tapir and orang-utang with defective roots are common articles of commerce in South Chinese apothecaries and come from caves in the Provinces of Kwangsi, Yunnan or Szechuan, where they represent the characteristic leading fossils of the so-called "yellow deposits."[2] The same fauna is characteristic of the Trinil beds in Java, for which reason it has been called the "Sino-Malayan" fauna. *Gigantopithecus* is apparently the hominid member of this faunistic association in South China, as are *Meganthropus* and the *Pithecanthropus* group in Java. The "yellow deposits" in the South China caves belong geologically to the Lower or Middle Pleistocene. The Trinil beds in Java which yielded all the hominid material we have spoken of are also considered as Middle Pleistocene formations. But there is evidence that at least one early hominid form, the baby skull of *Modjokerto* recovered by the Geological Survey of Netherlands Indies in 1936, goes down to the Djetis bed, which belongs to the Lower Pleistocene. On the other hand, the determination of the Trinil beds as Middle Pleistocene does not exclude the possibility that some of the fossils embedded in the layers are in reality older and washed into the beds by torrents and mud streams which accompanied volcanic eruptions very frequently during this whole geological period.

As the Sino-Malayan fauna immigrated into Java from the Asiatic continent, the different hominid forms, and certainly the most primitive ones, must have taken the same way. This may have happened in the Late Pliocene or in the Lower Pleistocene, at which time south-east Asia apparently was a seat of human evolution. Therefore, neither geological nor morphological facts can be produced against the assumption that *Gigantopithecus* is an ancestral hominid.

[2] Dr. C. C. Young, of the Geological Survey of China, my collaborator at the Cenozoic Research Laboratory in Peiping, who has just arrived in this country from Chungking, informs me that, according to investigations during the last few years, the caves containing the "yellow deposits" are widely distributed over the whole territory of South China south of the Yangtse River extending eastwards even to the coast, and that their fauna have the same character everywhere.

form which has been reduced in size and massiveness as it developed in the direction of modern man. *Sinanthropus pekinensis* is morphologically so close to *Pithecanthropus erectus* that he can be regarded as a parallel form of the latter. *Sinanthropus* may have taken its origin also from *Gigantopithecus*, with the only difference that in this case his transformation may have taken place on the mainland of Asia itself to the north of the original center.

All this is, of course, hypothetical and must be verified by additional and more complete material, and particularly by stratigraphic work on the sites concerned. Also the answer to another question which forces itself upon the mind has to be postponed until further evidences are at hand. Are gigantism and massiveness indispensable features of the earliest mankind and, consequently, characteristic of all human forms; or have they to be regarded as accidental, regional or individual variations as they occur in other mammalian groups? The occurrence of large fossil human skulls with very thick individual bones in early or late stages, for instance in *Homo soloensis*, *Homo rhodesiensis* and in the Heidelberg jaw, seem to indicate that gigantism and massiveness may have been a general or at least a wide-spread character of early mankind.[3]

ON NATURALLY OCCURRING PORPHYRINS IN THE CENTRAL NERVOUS SYSTEM[1]

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WE have found that the fluorescence spectrum of the white matter of the central nervous system, in numerous animals, reveals a well-defined emission band at 630–620 mμ with a maximum at about 625 mμ. When the brain and spinal cord of an adult rat are examined under the light of a mercury vapor lamp which has passed through a Corning filter No. 5874, the reddish fluorescence of the spinal cord is found to contrast strikingly with the greenish fluorescence of the cerebral and cerebellar cortex. When portions of white matter are removed from larger mammals, such as freshly killed monkeys, dogs or pigs, and examined, the 625 emission band is found to appear in the funiculi of the spinal cord, the fiber tracts of the pons and medulla oblongata, the medullary center and laminae of the cerebellum, the cerebral and cerebellar peduncles, the internal and external capsules, the corpus callosum, the fornix, the anterior commissure, the optic chiasm, the centrum semiovale and the medullary centers of the frontal, parietal, occipital and temporal lobes. The cortex and the basal ganglia, with the exception of the globus pallidus, exhibit a continuous fluorescence spectrum (about 630–430 mμ). The 625 band, although relatively weak, is found to be present in the globus pallidus, thalamus and lateral geniculate body.

Spectroscopic examination reveals the presence of the 625 band even in the white matter of a live animal. After death, the band is still present in animals killed with ether, chloroform, carbon monoxide, pentobarbital sodium, lactic acid, methylene blue, insulin, mescaline, bulbocapnine, metrazol, quinine, harmine or strychnine. Furthermore, an emission band in the red region remains present in the white matter: (1) after immersion in liquid nitrogen, (2) after boiling for 1 hour in distilled water, (3) after irradiation with 200 r or 2,000 r of x-rays and (4) after several weeks in darkness at room temperature. Exposure of the white matter to light, however, leads to a disappearance of the 625 band.

In examining the brains and spinal cords from animals of 33 different species, the 625 band has been found to be present in the white matter of all the following 25 species of mammals and birds studied: man, rhesus monkey, green monkey, cebus monkey, spider monkey, squirrel monkey, common brown bat, cat, dog, rabbit, guinea pig, rat, mouse, pig, ox, sheep, goat, hartebeest, Grant's gazelle, opossum, common rhea, duck, chicken, pigeon and great horned owl. On the other hand, we have been unable to detect the 625 band in any of the following 8 species of fully grown amphibians or reptiles: leopard frog, bull frog, iguana, gila monster, Texas collared lizard, bull snake, milk snake and indigo snake. It seems, therefore, that the fluorescence spectrum indicates the presence of a fundamental constituent of the white substance of warm-blooded animals. The position of the band and the fact that the spectrum is one of Dhéré's[2] Type I strongly suggest a porphyrin.

In an attempt to extract and identify naturally

[3] For details, illustrations and references the reader is referred to a paper of mine in preparation which will be published under the same title in the "Anthropological Papers of the American Museum of Natural History," Vol. 40.

[1] This research has been aided by a grant from the Committee for Research in Dementia Praecox founded by the Supreme Council 33°, Scottish Rite, Northern Masonic Jurisdiction, U. S. A.

[2] C. Dhéré, "La fluorescence en biochimie," Paris, 1937.

occurring porphyrins, we have chiefly used the acetic-acid-ether and the ethyl acetate-acetic acid methods.[3,4,5,6,7,8] The porphyrin which we have never failed to extract from the white matter of various mammals, including man, appears to have the characteristics of a coproporphyrin. The spectrochemical evidence has been derived from data on solubility, HCl number, and the fluorescence spectra in ether, acetic acid, 0.2, 5 and 25 per cent. HCl, concentrated H_2SO_4, pyridine, 5 per cent. $NaHCO_3$, 0.1 *N* KOH and 0.1 *N* NaOH. Measurements of the fluorescence spectra have furnished values which agree satisfactorily with those published in the literature[2,9,10] and with values found by measuring the fluorescence spectra of coproporphyrin extracted from the meconium of various animals or obtained from other sources. When the porphyrin in the 0.2 per cent. HCl fraction is driven into ether and then extracted with 20 per cent. NaOH, the porphyrin remains in the NaOH layer. There is no precipitation of insoluble sodium salts at the interface of the ether and NaOH solutions. When the porphyrin is taken into 0.2, 5 or 25 per cent. HCl and shaken with chloroform, all or almost all of the porphyrin remains in the HCl solutions. In measuring the fluorescence spectra of various porphyrins at the temperature of liquid nitrogen, we have found that the principal emission band of coproporphyrin in ether shifts about 60 Å towards shorter wave-lengths. Exactly the same shift is observed when the porphyrin in the 0.2 per cent. HCl fraction is taken into ether and studied under similar conditions. (In measuring the absorption spectra of porphyrins at liquid air temperature, Conant and Kamerling[11] have also found a shift towards shorter wave-lengths.[12]) At present we do not know whether the white matter contains coproporphyrin I or coproporphyrin III.

Extractions of the white matter also furnish varying amounts of protoporphyrin. When the original 5 per cent. HCl extract is esterified with methyl alcohol-HCl and the free porphyrins, after saponification of the ester, are studied, the spectrochemical evidence also points to the presence of coproporphyrin and protoporphyrin. No other ether-soluble porphyrins have been obtained in extracting either the white matter or the whole brain and spinal cord of normal animals.

Spectroscopic examination or extraction procedures have furnished no evidence for the occurrence of appreciable amounts of porphyrins in the pineal gland, the hypophysis, the chorioid plexuses, the cerebrospinal fluid, the aqueous and vitreous humors, and the meninges of the brain and spinal cord.

Postnatal development in mammals and birds seems to be characterized by an "ascending porphyrinization." The 625 band is not present at birth. It has been observed first in the spinal cord and, finally, in the white matter of the cerebral hemispheres. The band is definitely present in the spinal cord of rats 20 to 23 days old and in that of ducks 8 weeks old. Throughout life the band may remain more intense in the spinal cord than in the cerebrum. In numerous mammals the band appears less intense in the corpus callosum and fornix than in the centrum semiovale and less intense in the prefrontal lobes than, *e.g.*, in the occipital lobes.

The fluorescence spectra of the cranial nerves reveal marked differences. The 625 band is clearly present in the optic, trigeminal, facial and auditory nerves, but appears to be absent in the third, fourth and sixth nerves. We have not been able to detect it in the olfactory bulb. The 625 band is generally present in the olfactory tract, *e.g.*, sharp and well defined in the pig and dog, but weak or even absent in the monkey. Closer examination strongly suggests that the 625 band is always absent in the peripheral nonglial segment of the cranial nerves. Since the sensory roots contain longer glial segments than the motor roots,[13,14] the 625 band is chiefly a characteristic of sensory nerves. It is, of course, of special interest that the optic nerve contains one of the most remarkable photodynamic substances ever discovered. Although we have not ascertained the localization of the fluorescence phenomena within the white matter, the question arises whether the occurrence of porphyrin is correlated with the presence of neuroglia or, more particularly, the presence of oligodendroglia. In examining brain slices of animals with extensive cerebral lesions of long standing, the 625 band has been observed in all portions of the white substance.

[3] H. Fischer and H. Orth, "Die Chemie des Pyrrols." Vol. II, part 1. Leipzig: Akad. Verl., 1937.

[4] O. Schumm, Hdb. d. biol., *Arbeitsmethoden*, ed. by Abderhalden. Abt. IV, Teil 4, pp. 1439–1462.

[5] O. Schumm, *Arch. exp. Path. Pharmak.*, 191: 529–544, 1938.

[6] C. J. Watson, *Jour. Clin. Invest.*, 16: 383–395, 1937.

[7] K. Dobriner, *Jour. Biol. Chem.*, 120: 115–127, 1937.

[8] J. Thomas, "Contribution à l'étude des porphyrines en biologie et en pathologie." Lons-Le-Saunier, 1938.

[9] M. Borst and H. Königsdörffer, "Untersuchungen über Porphyrie." Leipzig: Hirzel, 1929.

[10] A. Stern and H. Molvig, *Zeits. physik. Chem.*, *Abt. A*, 175: 38–62, 1935; 176: 209–225, 1936.

[11] J. B. Conant and S. E. Kamerling, *Jour. Am. Chem. Soc.*, 53: 3522–3529, 1931.

[12] The splitting up and sharpening of bands found by Conant and Kamerling also occur in the fluorescence spectra of the porphyrins. As regards the shift to the blue, it may be noted that the principal emission band shifts about 60 Å at −195° C even in the fluorescence spectrum of fox squirrel bones.

[13] H. A. Skinner, *Arch. Neurol. Psychiat.*, 25: 356–372, 1931.

[14] I. M. Tarlov, *Arch. Neurol. Psychiat.*, 37: 1338–1355, 1937.

Furthermore, a strong emission band in the red region remains present in the white matter after incubation with solutions of myelolytic substances, such as saponin or sodium taurocholate.

In view of the presence of iron-porphyrin complexes in the central nervous system it deserves emphasis that the 625 band is absent in those regions in which the absorption bands of the cytochromes are clearly present (cerebral and cerebellar cortex, caudate nucleus, putamen). The 625 band is only present in regions which have little, if any, cytochrome. Keilin[15] has expressed the view that coproporphyrin is a derivative of cytochrome. Furthermore, we have not been able to detect the 625 band in the sympathetic and spinal ganglia or in the spinal nerves.

In examining tissues and organs of various animals, we have found that in the large majority of mammals and birds the fluorescence spectrum indicates the presence of porphyrin in only one organ. This organ is the central nervous system. That the porphyrins may play a significant rôle in neurological and psychiatric disorders has been suggested by several lines of evidence.[16,17,18,19,20,21] Numerous theories have been offered to account for the fact that acute porphyria produces such a wide variety of nervous and mental symptoms. In relating our results to facts and considerations reported in the literature, we are led to the hypothesis that certain neurological and psychiatric disorders are associated with a "cerebral porphyria" or a disturbance of the metabolism of certain pyrrol compounds.[22] Investigations are in progress to determine the distribution, amounts and kinds of porphyrins occurring in the brains and spinal cords of patients with various neurological and psychiatric disorders, ranging from demyelinizing diseases to the major psychoses.

OBITUARY

THOMAS SCOTT FISKE

Thomas Scott Fiske was born in New York City on May 12, 1865. He was the son of Thomas Scott Fiske, a business man of New York, and Clara Pittman. He studied at the Old Trinity Church School in New York City, and at the Pingry School in Elizabeth, N. J. He entered Columbia College in 1881, obtaining the A.B. degree in 1885, and continued graduate work in the university, earning the A.M. in 1886 and the Ph.D. in 1888.

His principal teacher at Columbia College was Professor Van Amringe, and Fiske was his assistant for several years. Van Amringe advised him to continue the study of higher mathematics at the University of Cambridge, England. This wise advice had a great influence on Fiske's intellectual career. (It will be recalled that most mathematicians of his period studied in Germany.)

Fiske was fortunate in arriving in Cambridge with letters of introduction from one of the Columbia trustees, George L. Rives, who had himself studied in Cambridge many years before, had in fact been one of the wranglers at the mathematical tripos in 1872, and had been offered a fellowship at Trinity, a very high honor. These letters were addressed to the well-known mathematicians, Cayley, Glaisher, Frost, Forsyth and George Darwin. So young Fiske was welcomed as a guest and attended lectures by most of these men. He also did private reading with Dr. H. W. Richmond.

Fiske himself stated that the teacher of greatest influence was Dr. Glaisher, who made him an intimate friend and traveled with him to London to meetings of the London Mathematical Society. To quote Fiske's own words: "On my return to New York I was filled with the thought that there should be a stronger feeling of comradeship among those interested in mathematics and I proposed to my classmates and friendly rivals, Jacoby and Stabler, that we should try to organize a local mathematical society."

These three young men, all born in the year 1865, sent out an invitation to local mathematicians, and on November 24, 1888, the first meeting was held in Columbia College, attended also by Van Amringe, Rees and Maclay. Thus began formally the New York Mathematical Society, with Van Amringe as president and Fiske as secretary. The society grew very rapidly, new members coming from Harvard, Yale, Princeton and Johns Hopkins. Six years later the membership was really national and the name of the organization was therefore formally changed to the American Mathematical Society. It is now the largest and most influential mathematical society in the world, having a membership of about three thousand. Fiske was the first secretary and the seventh president. He played the leading role in founding the two leading scientific journals, *The Bulletin* (1891) and *The Trans-*

[15] D. Keilin, *Proc. Roy. Soc. London* (*B*), 98: 312–339, 1925.

[16] J. Waldenström, *Acta med. scand.*, suppl. 82: 1–254, 1937.

[17] J. Waldenström, *Acta psychiat. neurol.*, 14: 375–379, 1939.

[18] H. Günther, *Ergebn. allg. Path. path. Anat.*, 20, part 1: 608–764, 1922.

[19] A. Vanotti, *Ergebn. inn. Med. Kinderhk.*, 49: 337–377, 1935.

[20] P. Eichler, *Zeits. ges. Neurol. Psychiat.*, 141: 363–379, 1932.

[21] C. Carrié, "Die Porphyrine." Leipzig: Thieme, 1936.

[22] H. Klüver, *Jour. Psychol.*, 17: 209–227, 1944.

actions (1900), and served on the board of editors in each case.

On the fiftieth anniversary of the society in 1938, Fiske received all honors as founder of the society. His portrait was painted for the occasion and now hangs in the rooms of the society in the Low Library of Columbia University. A full history of the first fifty years of the society, including a most complete account of Fiske's life and services, was written by Professor Archibald, of Brown University.[1]

Fiske was rapidly promoted in the department of mathematics at Columbia, becoming full professor in 1897 and the executive officer in 1915. He was an enthusiastic lecturer, equally interested in undergraduate and graduate work, inspiring many students. His main courses were in the theory of functions and differential equations. He published several technical papers in his early years, and a valuable monograph on functions of a complex variable, but his chief literary work was in the role of editor.

Fiske's name will always be connected with the American Mathematical Society, and also with another important organization, the College Entrance Examination Board. This was started in 1900 and the first secretary was Professor Nicholas Murray Butler. When Dr. Butler resigned as secretary, just before becoming president of Columbia, he asked Professor Fiske to take over the work, and to regard this service as a real portion of his duties as a professor, promoting the course of general education. Fiske was secretary from 1901 to 1936. Under his wise guidance the board grew from a small organization, examining 1,000 candidates for admission to twenty colleges, to 23,000 candidates to two hundred colleges.

When Fiske retired from Columbia and from the College Board in 1936, he settled in Poughkeepsie with his daughter, living the life of a country gentleman and keeping up many scholarly interests, until his death on January 10, 1944.

EDWARD KASNER

COLUMBIA UNIVERSITY

DEATHS AND MEMORIALS

DR. NORTON ADAMS KENT, who founded the department of physics at Boston University and was professor of physics there until his retirement in 1942, died on June 5 at the age of seventy years.

DR FREDERICK G. REYNOLDS, since 1891 until his retirement with the title emeritus in 1943 professor of mathematics and head of the department of the College of the City of New York, died on June 9 at the age of seventy-two years.

FREDERIC H. FAY, senior member of Fay, Spofford and Thorndike, engineers, Boston, a member of the Boston Planning Board for twenty years, died on June 5 at the age of seventy-one years.

DR AMOS ARTHUR HELLER, botanist of Chico, Calif., died at Vacaville, Calif., on May 18. He had at various times been connected with the University of Minnesota, the U. S. Department of Agriculture, the New York Botanical Garden and the University of Nevada.

THE *Journal* of the American Medical Association reports that a portrait of the late Dr. Howard Taylor Ricketts, who died of typhus in Mexico City on May 3, 1910, was unveiled on June 11 in the Archibald Church Library of the Northwestern University Medical School. The portrait is the gift of Mrs. Howard T. Ricketts and was presented by Dr. Henry T. Ricketts, son of Dr. Ricketts. It was unveiled by Robert Howard Palmer and Howard James Ricketts. Dr. Ludvig Hektoen, after an introduction by Dr. Irving S. Cutter, dean emeritus of Northwestern University Medical School, delivered the principal address. The portrait will hang permanently in the Archibald Church Library. A special exhibit of memorabilia depicting the work of Dr. Ricketts, who contracted typhus while carrying on research on the disease, will be on display.

SCIENTIFIC EVENTS

THE HAWAIIAN ACADEMY OF SCIENCE

THE Hawaiian Academy of Science held its eighteenth annual meeting on the evenings of April 27, 28 and 29 at the University of Hawaii, Honolulu. Scientific papers were presented on the first two evenings, and on Saturday the annual dinner and business meeting were followed by the address of the retiring president, Professor Carey D. Miller, who spoke on "Some Aspects of Growth and Food Needs."

For two years, owing to blackout restrictions and attendant travel difficulties, no evening meetings were held and meetings this year marked the return to the usual pre-war program. The average attendance has been about ninety. Thirty nominees were elected to membership. Officers elected for the coming year were: J. L. Collins, *President;* Peter H. Buck, *Vice-president;* Chester K. Wentworth, *Secretary-Treasurer;* T. A. Jaggar, Jr., and Colin G. Lennox, *Councilors* for one and two years, respectively; and Carey D. Miller, *Councilor, ex officio.*

The Hawaiian Academy of Science was founded in

[1] American Mathematical Society Semicentennial Publications, Vol. 1, 1938. I have borrowed most of my facts from this volume.

1925 and has a membership of about two hundred and seventy. An unusually wide range of interests is represented by the membership, both in special subjects in natural and social subjects and in the institutions by which they are employed, including the university and other educational institutions, the Bishop Museum, private and government experiment stations, various government agencies dealing with water supply, plant and insect control, public health and the like, as well as local clinics and hospitals and the military services. Contrasted climatic problems, geographic insularity and diversified racial and cultural patterns and trends in Hawaii have combined with a vigorous financial-industrial status to produce a varied and healthy development of scientific activity which on a per capita basis is probably matched in very few areas in the world.

The following papers were presented at the scientific sessions: "Summary of a Chemical and Physiological Study of the Toxic Principle in *Leucaena glauca* (Koa Haole)," by Ruth Yoshida (presented by J. H. Beaumont); "Certain Biological Aspects of Mosquito Control in Hawaii," by David D Bonnet; "Fishery Research in Hawaii," by Christopher J. Hamre; "Exchangeable Potassium in Some Oahu Soil Profiles," by A. S. Ayers and C. K. Fujimoto; "Flow of Liquids through Narrow Cracks," by Chester K. Wentworth; "Active Volcanoes in the War Zones," by T. A. Jaggar with the assistance of Gunnar Fagerlund.

CHESTER K. WENTWORTH,
Secretary

THE SCHOOL OF PUBLIC HEALTH OF THE UNIVERSITY OF CALIFORNIA

THE first School of Public Health west of the Mississippi has been established at the University of California. The school was set up by the Board of Regents after the State Assembly passed a bill appropriating funds. Dr. Walter H. Brown, chairman of the department of hygiene, has been appointed acting dean.

There has long been need for a training center in the western part of the continent to train public-health personnel for service not only in the western United States, but for service in the entire Pacific Basin and Latin America. It is expected that the new school will operate as such a training center.

The providing of courses and curricula on both undergraduate and graduate levels is contemplated, and plans will be developed for the graduate training of health officers, epidemiologists, public health engineers, industrial hygienists and other specialists.

Planned as a university-wide undertaking, using the resources of all campuses, the school is being organized as a cooperative enterprise, involving the participation of several other schools and departments within the university, including those in the fields of medicine, medical research, education, nursing, home economics and sanitary engineering. The department of hygiene will be renamed the department of public health and will function as part of the School of Public Health.

Among the first service activities of the school were two special training courses for sanitarians, one being given at Berkeley during the spring semester and one at Los Angeles during the summer term. These courses were requested by the State Department of Public Health to help to meet increasing demands on public health workers in coping with emergency conditions in the western states. They are open to public-health personnel selected by Boards of Health in California and adjacent states. The courses consist of eight weeks' academic instruction and four weeks' field work.

At the request of the Coordinator of Inter-American Affairs through the Division of Health and Sanitation fifteen Latin American students are being trained specifically for health education activities in their respective countries. Their program consists of two sixteen-week terms and will cover problems of nutrition and personal hygiene, communicable diseases, environmental sanitation, general education and sociology, public health administration and health education.

In addition to the faculty of the School of Public Health the teaching staff for the Latin American program will include Dr. Clair E. Turner, head public health education officer, Division of Health and Sanitation, Office of Coordinator of Inter-American Affairs; members of the School of Education and the departments of home economics and social welfare at Berkeley; the Medical School at San Francisco; and representatives of the U. S. Public Health Service, the Children's Bureau of the Department of Labor and the State Department of Public Health.

At the conclusion of the two academic terms at Berkeley, the Latin American students will spend a period in field practice as a final preparation for their duties upon returning to their home countries.

THE GUTHRIE LECTURE

DR. JOEL H. HILDEBRAND, professor of physical chemistry at the University of California, who has been in London during the past year as a scientific liaison officer for the Office of Scientific Research and Development attached to the American Embassy, is now in the United States on a brief furlough. Dr. Hildebrand delivered the Guthrie Lecture at the Royal Institution, London, on April 26. It was repeated at the Clarendon Laboratory of the University of Oxford on April 29. The subject of the lecture was "The

Liquid State." Dr. Hildebrand expects to return to London at an early date.

The introduction to the lecture was made by Professor E. N. da Costa Andrade, Quain professor of physics at the University of London, adviser to the director of scientific research of the British Ministry of Supply, who spoke as follows:

We are met to-day for our chief annual function, the Guthrie Lecture. For the benefit of our guests and new fellows, I may explain that it was founded in 1914 to perpetuate the memory of our founder, Professor Guthrie, who himself became our president in 1884, ten years after the foundation of the society. We have to deplore the death, since our last lecture, of Mrs. Guthrie, who always attended, but we are pleased to be able to welcome members of the Guthrie family, as usual.

This lecture has been given in the past by many distinguished men. Among our own countrymen I may recall the names of Sir J. J. Thomson, Lord Rutherford, Sir C. V. Boys, Lord Cherwell, Professor A. V. Hill, Sir Edward Appleton; among Frenchmen, Langevin, Guillaume and Fabry; among Germans, Wien and Planck; among Scandinavians, Bohr and Siegbahn. The very first Guthrie Lecture was given by an American, Professor R. W. Wood, and on three other occasions we have been addressed by Americans—Albert A. Michelson, P. W. Bridgman and A. H. Compton, a distinguished company indeed. This year we have the great pleasure of adding another American name to the list, that of Professor J. H. Hildebrand. Bridgman and Compton were from Harvard, near the extreme east of the States; Wood was from Baltimore, not so far distant; Michelson from Chicago on the Great Lakes. This year we travel to the West Coast, to Golden California, and borrow one of her choicest spirits.

And here I may say that we have been brought up to believe that everything in California is very large. As the poet says:

> And the cattle on the hills of California
> And the very swine in the holes,
> Have ears of silk and velvet,
> And tusks like long white poles,

and that perhaps at first we were a little bit disappointed that Hildebrand was not bigger, but we soon got to know that his heart was built on a Californian scale.

It is not often that our council has had so easy a task in choosing the Guthrie lecturer as they had this year. It is seldom that in any of the affairs of life the heart and the head can agree completely, and still more seldom that they can then make common cause with international politics. This year, however, the promptings of friendship, the pleadings of reason and the pressure of political feeling all urged us to choose Dr. Hildebrand. I have put friendship first, because many of those present —and by many I mean all those who know him personally—feel for him something more than mere regard. His unaffected good will, his geniality, his modesty and his good fellowship have endeared him to his English colleagues. But even if he had been less cordially liked we should probably have asked him to deliver this lecture because of his eminence as a physical chemist and, in particular, because of the interest of his subject and of its novelty to most of us. And even if he had been only tolerably liked and moderately distinguished, even if his appeal to our hearts and our heads had been less strong, we should still have liked to have him here to-day as a gesture of affection to our American colleagues with whom we work in such amity in the fields of science. As it is, everything conspired to commend Dr. Hildebrand to us and it was with the greatest pleasure that we received his favorable answer to our invitation.

To-day is something of an American occasion. I have already referred to our former Guthrie lecturers from the United States. By courtesy of the managers we are able to assemble in the lecture theater of the Royal Institution. The institution was founded in 1799 by the celebrated Benjamin Thompson, Count Rumford, who was an American by birth and upbringing and who spent much time in this very theater. I am glad to say that among the small number of honorary members of the institution are a good proportion of Americans, including Professor G. N. Lewis, of the University of California.

Here Professor Andrade read a letter from Ambassador Winant regretting his inability to attend.

And now, in the name of the council of the Physical Society, I invite you, Dr. Hildebrand, to deliver the twenty-eighth Guthrie Lecture and I assure you that you have before you an audience of friends.

At the close of the lecture a vote of thanks was moved with appropriate remarks by Professor Oliver Rankin, formerly president of the Physical Society, and seconded in like manner by Sir Henry Dale, president of the Royal Society. At Oxford the same ceremony occurred, with the vote of thanks moved by Lord Cherwell and seconded by Professor N. V. Sidgwick.

HONORS IN THE SCIENCES AWARDED BY COLUMBIA UNIVERSITY

AT the one hundred and ninetieth commencement of Columbia University the doctorate of science was conferred on Dr. Lyman James Briggs and Te-Pang Hou. The citations were as follows:

LYMAN JAMES BRIGGS: Physicist; native of Michigan who quickly turned to scientific work of high importance and passed from one post of honor and confidence to another; becoming in 1933 director of the Bureau of Standards; closely associated with a score of important scientific organizations and undertakings; always a stimulating leader in thought and research.

TE-PANG HOU: Chemist and engineer; born in China and trained first in his homeland and afterwards in the United States; returning to China for pioneer service in establishing for the first time on the continent of Asia a modern chemical industrial plant of imposing productive capacity, thus enabling the West to repay in part a debt centuries old to the Chinese nation.

University medals were awarded to:

CHESTER ALAN FULTON: E.M., 1906; president of the

American Institute of Mining and Metallurgical Engineers; most effective administrator and research worker in his chosen field.

JAMES TAYLOR KEMP: B.S., 1912; Met.E., 1916; metallurgist of distinction; now in England as a member of the Mission for Economic Affairs.

SCIENTIFIC NOTES AND NEWS

THE University of Florida at its commencement on May 29 conferred the degree of doctor of science on Dr. Thomas Barbour, director of the Museum of Comparative Zoology of Harvard University.

THE University of Akron, Ohio, conferred on June 4 the honorary degree of doctor of science on Bradley Dewey, director of the Office of the Rubber Division of the War Production Board. Mr. Dewey was the guest speaker, his topic being "Synthetic Rubber and the University of Akron—Now and in the Future."

THE honorary degree of doctor of science was conferred at the commencement of the University of Maine on Dr. William H. Martin, dean of the College of Agriculture and director of the Agricultural Experiment Station of Rutgers University, in recognition of "splendid achievements in the fields of education and science."

AT the one hundred and twelfth commencement of New York University the doctorate of science was conferred on Dr. Otto Loewi, research professor of pharmacology at the university.

THE Trudeau Medal for meritorious achievement in the prevention and treatment of tuberculosis of the National Tuberculosis Association was awarded on May 10 at a meeting in Chicago to Dr. James Alexander Miller, professor of clinical medicine at the College of Physicians and Surgeons of Columbia University and director of the Tuberculosis Clinic of Bellevue Hospital.

THE Royal Society of Canada, at its meeting in Montreal on May 29, awarded the Henry Marshall Tory Medal to Frank Allen, professor of physics at the University of Manitoba, "in recognition of his researches in the senses of vision, hearing, touch and taste." Dr. Allen, who founded the department of physics in 1904, was professor of physics and head of the department. He will retire on August 31. He has been appointed professor emeritus effective on September 1.

DR. HOWARD MUMFORD JONES, dean of the Graduate School of Arts and Sciences of Harvard University, has been elected president of the American Academy of Arts and Sciences, Boston.

AT the anniversary meeting of the Royal Institution, London, Lord Eustace Percy was elected president and Major Charles E. S. Phillips was elected secretary.

PROFESSOR GRACE MACLEOD, professor of nutrition at Teachers College, Columbia University, chairman of the Nutrition Committee of Greater New York, is retiring with the title emeritus after teaching at the college for twenty-five years. Students of the class in nutrition for 1944 are starting a Grace MacLeod Loan Fund for graduate students in nutrition at the college.

PROFESSOR MARSHALL KAY, in charge of instruction and research in stratigraphy in the department of geology of Columbia University, has been promoted from an associate to a full professorship.

DR. MORRIS STEGGERDA, who has been connected for the past fifteen years with the department of genetics of the Carnegie Institution at Cold Spring Harbor, has been appointed professor of anthropology at the Kennedy School of Missions, a division of The Hartford Seminary Foundation.

DR. LESLIE W. FOKER, director of the Minnesota Division of Industrial Health, is chairman of a new industrial nutrition committee, established in cooperation with the Nutrition in Industry Service of the U. S. Food Distribution Administration.

DEAN WILLIAM I. MYERS, of the New York State College of Agriculture; Dr. L. A. Maynard, director of the School of Nutrition at Cornell University, and C. Chester Dumond, New York State Commissioner of Agriculture, have been appointed members of a New York State Postwar Planning Committee to avoid chaotic food conditions after the war.

DR. ERNEST J. JAQUA, Eugene, Ore., formerly president of Scripps College, Claremont, Calif., has been appointed educational director of the Baruch Committee on Physical Medicine. Members of the scientific advisory committee are Dr. Frank H. Krusen, Rochester, Minn., *Chairman;* Dr. Jaqua, *Secretary;* Dr. John Stanley Coulter, Chicago; Dr. John Farquhar Fulton, New Haven, Conn.; Dr. Charles Gordon Heyd, New York; Dr. Andrew C. Ivy, Chicago; Dr. Chauncey D. Leake, Galveston, Texas; Dr. Frank R. Ober, Boston; Dr. Winfred Overholser, Washington, D. C.; Dr. Francis O. Schmitt, Cambridge, Mass., and Dr. Ray Lyman Wilbur, Stanford University, Calif., member *ex officio.*

THE Worcester Foundation for Experimental Biology announces the appointment of three new research members: Dr. Erwin Haas, of the University of Chicago; Dr. Robert P. Jacobsen, of the U. S. Public Health Service, and Dr. Oscar M. Hechter, of the

University of Southern California. Dr. Haas's work is primarily in the field of respiratory enzymes. Dr. Jacobsen is a steroid chemist, and Dr. Hechter's contributions have been primarily in endocrinology.

DR. JOHN HARLAND PAUL, in charge of malaria control in Haiti, has been appointed director of the Bureau of Malaria Control of the Florida State Board of Health.

DR. LAWRENCE W. BASS, director of the New England Industrial Research Foundation, Boston, previously assistant director of Mellon Institute, has been appointed associate director of chemical research for the Air Reduction Company, Inc., and the United States Industrial Chemicals, Inc.

DR. JACOB SACKS, formerly assistant professor of pharmacology of the Medical School of the University of Michigan, has joined the staff of Endo Products, Inc., as director of the pharmacological laboratory.

DR. RAMON F. HANZAL, assistant professor of pathological chemistry at the School of Medicine of Western Reserve University, has become a biochemist with the Killian Research Laboratories in New York City.

DR. LAWRENCE C. CURTIS, geneticist at the Connecticut Agricultural Experiment Station, who has been a member of the staff for fourteen years, has been granted a year's leave of absence to serve as a member of a food mission to North Africa with the Division of Relief and Rehabilitation of the Foreign Economic Administration. The mission will study the production of food crops in North Africa and the distribution of these crops to the Allies and to liberated countries.

DR. PAUL O. MCGREW, of the division of geology of the Chicago Natural History Museum, left for Mexico on June 8 to make a study of the volcano El Parícutin, which on February 20, 1943, erupted suddenly. Since that time it has grown into a volcanic cone rising 1,200 feet above the ground surface, giving out volcanic bombs, cinders and ash and clouds of gases.

DR. HARLOW SHAPLEY, director of the Harvard College Observatory and national president of the Society of the Sigma Xi, gave the address at the spring initiation meeting of the Smith Chapter on April 11. The title of the lecture was "Reaching for the Stars."

DR. C. E. KENNETH MEES, director and vice-president of the Eastman Kodak Company, will be the speaker at the dinner on June 23 of the Rochester meeting of the American Physical Society and the American Association of Physics Teachers. The address will be entitled "The New World and the Scientist."

THE inaugural meeting of the new Division of High-Polymer Physics of the American Physical Society will be held on June 23 and 24 at the University of Rochester. A program of approximately twenty selected papers on the elasticity, viscosity and other physical properties of high-polymeric materials, as well as on the application of physical methods to manufacturing processes, has been arranged. Recognizing the expansion in the applications of physics and physical techniques arising from the recent rapid development of the field of high-polymeric materials, the council of the society last November authorized the establishment of the division. Its object is the advancement and diffusion of the knowledge of the physics of high-polymeric materials. The interests of the division will be sufficiently broad to appeal to physicists in academic, industrial and governmental laboratories. The inaugural program at Rochester is being sponsored by members of an organizing committee of which Dr. W. J. Lyons, Southern Regional Research Laboratory, 2100 Robert E. Lee Boulevard, New Orleans 19, Louisiana, is serving as secretary.

THE fifty-seventh regular meeting of the Iowa Academy of Science was held in Cedar Rapids on April 15. The attendance was about two hundred, and papers were read before the sections of botany, chemistry, geology, mathematics, physics, psychology, science teaching and zoology. Dr. E. R. Smith, of the Iowa State College, delivered the presidential address; Dr. J. N. Martin and Dr. C. W. Lantz presented papers of general interest; Dr. L. R. Laudon, of the department of geology of the University of Kansas, gave an illustrated address entitled "Oil from the Arctic." Sixty-eight papers were presented at meetings of the sections. Officers of the academy elected for 1944–45 are: *President,* Ben H. Peterson, Coe College; *Vice-president,* Joseph C. Gilman, the Iowa State College; *Secretary-Treasurer,* Cornelius Gouwens, the Iowa State College.

THE first annual meeting of the Potomac Division of the American Phytopathological Society at the station of the Bureau of Plant Industry at Beltsville, Md., was a war conference to facilitate an exchange of ideas among the plant pathologists of Maryland, Delaware and the U. S. Department of Agriculture. The attendance was approximately one hundred. Nineteen papers representing results of original research were presented. In addition to the research papers, quarantine protection problems and war-time work in plant pathology were discussed. Officers for the Potomac Division for 1945 are: *President,* H. B. Humphries; *Vice-president,* W. J. Zaumeier; *Secretary-Treasurer,* T. F. Manns, and *Representative on Council,* H. P. Barss.

THE semi-annual meeting of the American Society

of Mechanical Engineers will be held at Pittsburgh from June 19 to 22. In addition to a full program of technical papers, there will be a panel discussion on developments in industrial furnaces; a symposium on instrument controls action and one on controlled atmospheres in metals engineering. Igor I. Sikorsky will be the speaker at the dinner of the society on the evening of Wednesday, June 21.

THE Washington Branch of the American Association of Scientific Workers has arranged a symposium for Friday evening, June 16, at 8 o'clock, in the Auditorium Archives Building on "The Utilization of Scientific Personnel in Wartime" under the chairmanship of R. H. Montgomery, economic adviser to the executive director of the Foreign Economic Administration. The speakers are Dr. Vannevar Bush, director of the Office of Scientific Research and Development, and Colonel John N. Andrews, office of the director of the Selective Service System.

THE Fifth Conference on Science, Philosophy and Religion will meet at the Men's Faculty Club of Columbia University over the week-end of September 7. In accordance with the practice adopted last year, attendance will be limited to members and participants in the program. There will be no public meetings.

AT the ninety-seventh annual general meeting in London of the British Palaeontographical Society, a committee was appointed to consider plans for the commemoration in 1947 of the centenary of the society.

THE John and Mary R. Markle Foundation has authorized a grant-in-aid of $5,400 annually, for a two-year period, in support of research on experimental renal hypertension at the University of Illinois College of Medicine, Chicago. The work, which was initiated in 1942, under a two-year grant of $7,000 from the foundation, is being conducted under the direction of Dr. George E. Wakerlin, professor of physiology and head of the department.

THE Sugar Research Foundation has made grants amounting in all to $104,000 for research on sugar to the following recipients: Dr. Ancel B. Keys, professor of physiology at the University of Minnesota; Dr. Julian A. Boyd, associate professor of pediatrics at the Iowa State University; Dr. Frederick J. Stare and Dr. A. Leroy Johnson, both of the School of Medicine and Public Health of Harvard University; Dr. Melville L. Wolfrom, professor of chemistry at the Ohio State University, and Dr. Carl Neuberg, professor of chemistry at the Washington Square College of New York University.

THE University of Arizona is acquiring the private herbarium of Dr. Forrest Shreve, of the Carnegie Institution of Washington. The collection contains 30,000 specimens and is recognized as an excellent representation of the Mexican flora. About half the specimens are from Mexico, mainly from the northern half of that country. The other half of the collection is chiefly from the southwestern states with about 1,500 sheets from Maryland, Georgia and Alabama, and an undetermined number from Jamaica. The Mexican plants include a considerable number of old collections made by Pringle, Palmer, Marcus Jones and Purpus. The more recent material includes sets of nearly all the important collections that have been made in Mexico since 1930. Included among the specimens are nine types, about 200 topotypes and about 300 isotypes.

CHANGES in the undergraduate curriculum of the Massachusetts Institute of Technology to meet the special requirements of education in science, engineering and architecture after the war have been approved by the faculty. The plan is the result of months of study by a faculty committee appointed to consider simplification of courses. Members of the committee were Professor Earl B. Millard, *Chairman;* Professor Leicester F. Hamilton, Registrar Joseph C. MacKinnon, Professor George W. Swett, Professor Arthur L. Townsend, Professor Carlton E. Tucker and Professor Bertram E. Warren. The most important feature of the revision is a coordinated four-year program in the humanities and social sciences which emphasizes the long-established educational philosophy of instruction of the institute in the ethical and social implications of science and technology.

DISCUSSION

A NOTE ON EQUATIONS OF GROWTH[1]

IT is an altogether too well-known fact that the growth of diverse cellular populations can not be described by a single growth equation, merely by changing the numerical values in the "constants" so as to fit each case. Much less realized is the equally evident fact that a single differential equation with

[1] In accordance with Art. 113(2) U. S. Navy Regulations, the opinions or assertions contained herein are the private ones of the writer, and are not to be construed as official or reflecting the views of the Navy Department or Naval Service at large.

fixed constants is generally unable to describe even the entire lifetime of one cell community. The first of these serious difficulties suggests that an equation may be too committing and limited and is thus unable to grasp the "common denominator" of all growth. A promising solution to this problem is to fix attention on the form of the differential or integro-differential equation. This point of view has been argued elsewhere.[2] The function most commonly used, and for which there is considerable theoretical justification, is the polynomial in N,

$$\frac{dN}{dt} = h_1N^{\gamma_1} + h_2N^{\gamma_2} + \qquad + h_mN^{\gamma_m} \tag{1}$$

where N is the cell number (or some parameter linearly proportional to it), and the h_j are aptly[3] called the vital coefficients. In recognition of the first-mentioned difficulty of the growth problem, it is to be understood that only some of the terms in (1) will appear, depending on what sort of growth is being analyzed. The second difficulty—with which this paper is concerned—leads to the further admission that the h_j are in some way dependent on time. This situation has been clearly realized by Kostitzin (*ibid.*), who has suggested an analytic treatment based on dividing up the life span of the colony into physiological phases. He then writes for each phase one equation with constant vital coefficients. The values of these constants, however, change discontinuously from phase to phase, while the final value of N in one phase becomes the initial value of N in the next. While in a qualitative sense the notion or discrete physiological phases is useful, it is obvious that a full treatment of the problem must be based on analyzing continuous changes. This involves giving rational interpretations to the vital coefficients, and therefore explicitly predicting how they shall vary in time. An attempt of this sort has been made elsewhere.[4] In certain cases the resulting differential equation is directly integrable. Such a procedure is what might be called the direct solution of the growth problem.

Usually, however, it is impossible to solve the differential equation by any practical method, and one must wait upon the evolution of other procedures. In the meantime the following simple analysis can be of considerable value.

Let us suppose that on the basis of a knowledge of the physical situation one writes the differential equation of the system as,

$$\frac{dN}{dt} = \sum_{j=o}^{j=m} h_j N^{\gamma_j} \tag{2}$$

[2] M. F. Morales and N. W. Shock, *Bull. Math. Biophys.*, 4: 63, 1942.
[3] V. A. Kostitzin, "Mathematical Biology," George S. Harrap, London, 1939.
[4] M. F. Morales and F. L. Kreutzer, submitted.

Defining two differential operators, H:

$$H^0 \equiv 1$$

$$H^1 \equiv \frac{1}{\frac{dN}{dt}} \frac{d}{dt}$$

We may generate from (2) the set of equations by successive application of the H:

$$H^i\left(\frac{dN}{dt}\right) = \sum_{j=o}^{j=m} h_j \left[\frac{\gamma_j!\, N^{\gamma_j - i}}{(\gamma_j - i)!}\right],\ i = 0, 1, 2 \tag{3}$$

So far as the h_j are concerned (3) is a linear set. Letting i run to the value m, it is evident that the values of all the h_j *at the point* (N, t) can be determined by usual methods as,

$$h_j = \frac{\begin{array}{cccccc} p_{oo} & p_{oi} & \cdots & p_{jo-1}\, H^0 \dfrac{dN}{dt} & \cdots & p_{on} \\ p_{io} & p_{ii} & \cdots & p_{ij-1}\, H^i \dfrac{dN}{dt} & \cdots & p_{in} \\ p_{mo} & p_{mi} & \cdots & p_{mj-1}\, H^m \dfrac{dN}{dt} & \cdots & p_{mm} \end{array}}{|p_{ij}|}$$

where $p_{ij} = \dfrac{\gamma_j!\, N^{\gamma_j - i}}{(j-i)!}$ or 0 according as $j \geqq i$ or $j < i$, provided that N and all the $H^i\left(\dfrac{dN}{dt}\right)$ be known. This is by no means a hopeless task. The experimental curve of the growth gives N. Well-known graphical methods give $\dfrac{dN}{dt}$ and by the indicated combinations of these it is possible to obtain all the products of the operator H. These operations are then performed for as many points as are consistent with accuracy and convenience.

The result is that by straightforward and simple methods it is possible to follow the time changes in the vital coefficients, and therefore to support or disprove the theoretical interpretation that has been assigned to them. This in turn substantiates or vitiates the differential form (1) attempted.

MANUEL F. MORALES, *Ensign, U.S.N.R.*

TRANSLITERATION OF RUSSIAN NAMES AND WORDS

IN the course of the past months a number of notes appeared in SCIENCE in relation to transliteration of Russian names and words into English. The latest of these is that by C. S. Hoare (April 21 issue of SCIENCE).

I wish to point out that one factor appears to escape the discussion in most cases. It is simply this: Is the transliteration to be used for filing purposes and be independent of the language of the user, or is it to be a guide for writing the proper sound of the

Russian words in the language of the user and thus make him able to pronounce the words reasonably accurately?

If the former is the case, then, of the number of systems which have been presented, there does not seem to be a single one which is adopted universally, which is unfortunate.

If the latter, however, is the case, then surely no point is gained in using Chech alphabet to signify Russian words to an English-speaking person. The latter would have to learn Chech to learn Russian. Surely, the direct process is simpler and more direct. I wish to point out that for the purposes of both reasonably correct pronunciation and ready filing, the system used by the *Chemical Abstracts* (readily obtainable by writing to the editor) is by far the simplest and reduces Russian to English letters and not to some third intermediate or synthetic language.

G. M. KOSOLAPOFF

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EDITORIAL CHANGES OF SCIENTIFIC PAPERS

THE discussions on editorial changes of scientific papers which have appeared in SCIENCE[1] have been very valuable—not alone because they have discussed equine serum and horse serum but because they have brought out several worthwhile points of view. May I add to the discussion for what it may be worth, and may I by way of introduction suggest that the *Proceedings* of the American Society for Horticultural Science, to which I am referring and in which I have a hand, is not being held up as an example of superior editing. It has, however, over a period of years developed an editorial policy which leaves to the author the final decision in controversial matters. And this has come about in part through a number of sad experiences.

First, about twenty-five years ago a manuscript was submitted by a young scientist, which was rejected by our editorial committee and later published in an experiment station bulletin. The bulletin has become a classic in the literature of plant science. Second, about ten years ago, a paper by a recognized authority in genetics was submitted anonymously to another recognized authority in genetics for review. The reviewer termed the paper inconsequential and branded the author as knowing little about the field of genetics. The author in turn replied that the reviewer did not understand the paper and evidently was not a geneticist. Experiences such as these leave an editor shuddering and horrified. Needless to say, they affect one's viewpoint.

And so, the editorial policy of the American Society for Horticultural Science has been to throw the responsibility back upon the author. We say to the reviewer, "Final approval or rejection of suggestions lies with the author. . . . Suggestions are to be considered from the standpoint of being helpful to the author in presenting the data." We say to the author, "You are at liberty to accept or reject the criticisms." Obviously, editorial supervision is exercised over elementary spelling and grammar, but these are hardly matters of controversy. And, where an author prefers, "scion" becomes "cion," "clone" becomes "clon" and "sweetpotato" becomes two words. By common standards this is, of course, poor editing.

But we do try to have the material understandable, and we try to help the author to this end. We lean, though we do not encourage it, towards the side of letting a man "make a fool of himself in his own way." And sometimes he proves to be not so much of a fool as was at first suspected.

In short, our policy is focused around an attempt to be helpful; we try to humanize the relation between editor and author; we suggest changes and leave to the author the final judgment and control of the situation. The result is a very gratifying response, close understanding and excellent working relations.

To be sure, the topic of editorial supervision and control is not quite so simple as this point of view might seem to imply. There are such matters to consider as cost of printing, space on library shelves, cluttering of the literature, nature of the publication medium, nature of the material to be published, audience to be served, helpfulness to the reader and even protection of the author from himself. They carry different weights in different situations.

Stuart P. Sherman once said to his class in English at the University of Illinois, following an address by Sergeant Alvin C. York, in which there was some criticism of the grammatical expressions used by Sergeant York in addressing the German machine gunners, "They understood him, didn't they?" The point is that part of the effectiveness of Sergeant York's reply was in the way he said it—it was distinctly his way, and as such it may have carried far clearer meaning than had it been altered by an editorial committee to suit some arbitrary standards. At least, "he got results."

H. B. TUKEY,
Secretary, American Society for Horticultural Science

GENEVA, N. Y.

[1] SCIENCE, August 27, 1943, January 21, 1944, and March 24, 1944.

PROPOSAL FOR ACCELERATED DISSEMINATION OF SCIENTIFIC KNOWLEDGE

AFTER three years of blockade, which strangled the inflow of scientific literature, the gift of microfilms has been most warmly welcomed by Chinese research-

ers and students. But the fact that it still requires at least 22 days for the information to reach destination (one week for an article to get published in a weekly periodical like SCIENCE, one day to process the microfilm and two weeks to air transport to Kunming) has set the writer thinking of a plan for reducing this time lag to a minimum, which is embodied in the following proposal.

Although the preferred procedure of publishing matters of scientific import is still via the printed journal, the microfilm has already taken over a part of this function, especially in the case of lengthy papers on restricted subjects, where nowadays only an abstract is published and the original microfilmed on application. If photography can effect an earlier appearance of papers of a particular type, the radio, if drafted into service, should revolutionize the circulation of scientific publications of all kinds—be it a short note or a monographic treatise. By radio broadcasting, any scientific information can reach its intended audience the world over in the space of a few hours, certainly not requiring a 22-hour interval. By agreeing on a system of codewords, diagrams, graphs and formulas may be broadcast almost as readily as the text itself, until developments in television should place in our hands facilities not now available. By enlisting the aid of the highest research organizations of the leading United Nations, special stations can be established and maintained for the express purpose of science broadcasting.

For preserving the speeches in permanent form, the system of recording from the loudspeaker, long in use by the radio stations, is admirably adapted to this purpose. The only improvement to be made is the substitution with Cellophane tapes, as recently developed by Fonda, for the familiar discs of resinous composition. While the discs require frequent changes and therefore interruptions, the Cellophane tapes permit continuous recording for eight hours. With this semi-automatic system, the actual recording can be attended to by a trained assistant, and the need of arranging a suitable time to both the sending and receiving stations is entirely obviated. In case an article treats of a highly technical subject, a specialist in the particular field may be called in to take down the playback. From this transcript, mimeographed or printed copies can be made for wider distribution.

From journal articles this practice can be extended to books of considerable length. The royalty problem can be readily solved by reference to precedents established in the other fields of radio broadcasting. If only a digest is broadcast, it may prove a virtual stimulus to the sale of the printed book.

The desirability of accelerated dissemination of scientific knowledge is too well understood to require stressing here, but it may be pointed out that broadcasting would tend to unify the scientific language, itself a potent stabilizer of the peace to come. Having experienced the effect of intellectual isolation, the writer is prompted to bring this proposal to the consideration of the scientists and statesmen of the Allied countries. If it can not conveniently be acted upon during the war, it certainly will be our main concern after the war. We are on the threshold of a new age of contracted space and diminished time and the present suggestion is in keeping with this spirit of the future.

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SCIENTIFIC BOOKS

CHIMPANZEES

Chimpanzees. A Laboratory Colony. By ROBERT M. YERKES. xv + 321 pp. Illustrated. Yale University Press. 1943. $5.00.

THIS book is the story of an unusual project in psychobiology. It gives the history of Professor Yerkes's work with chimpanzees over a seventeen-year period and does it in an engaging manner. The book will interest the biologist, the psychologist, the medical man and also the general reader.

Yerkes successfully developed a colony of chimpanzees through controlled breeding and rearing of experimental animals. In the course of the work he faced many practical problems relating to such necessities as feeding, housing, hygiene, health, disease prevention and cure. A considerable body of general information was accumulated about chimpanzee structure and function, instincts, habits and other behavior patterns both in captivity and the native habitats. There are discussions of such topics as emotional traits, social relations, drug addiction and susceptibility, parasitic control and related problems of health. A special chapter is devoted to memory, foresight and insight, and another to language and symbolism. An entire section of the book is concerned with care and handling. An epilogue tells the story of the genesis, development and realization of a research idea. There is a selected bibliography of references. The book is richly illustrated by photographs of apparatus and pictures of animals in a variety of experimental situations. Yerkes is very generous in giving credit to his students and associates for their many contributions.

The reviewer encounters a degree of difficulty in formulating a systematic evaluation of the subjects included in Yerkes's volume, because the diversity of subject-matter does not lend itself to such treatment. However, the bulk of the research is concerned with the behavior endowment of the chimpanzee, and represents a selection from studies originally reported in monograph form.

The choice of any special group of experiments for special mention merely represents the interests of the reviewer. To him, the symbolic behavior described in the chapter on "Language and Symbolism" is of special value because of its close resemblance to the same type of behavior in humans. These experiments deal with the chimpanzees' ability to use tokens in problem solving.

The book is full of useful information for the practical caretaker of the chimpanzee as well as for the research man. It will, in fact, have a wide appeal even for those engaged in other fields. The specialists in the areas treated will find helpful summaries and useful comments on some of their problems. Any one interested in a book on animal life, written primarily from the personal experience of a man who has spent his professional career in the laboratory, will find it both illuminating and entertaining because of its diversity of scientific interests. The general reader will discover much that is both informative and intrinsically interesting in this volume. There are a number of episodes concerning the relations of the chimps with the caretakers and experimenters which indeed make entertaining reading.

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ORGANIC CHEMISTRY

Organic Reactions. Vol. II. ROGER ADAMS, editor-in-chief; WERNER E. BACHMANN, LOUIS F. FIESER, JOHN R. JOHNSON and H. R. SNYDER. Pp. iv + 461. New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd. 1944. Price, $4.50.

IN the October 2, 1942, issue of SCIENCE, p. 319, Vol. I of this series was reviewed and attention called to the announced intention of its editorial board to issue additional volumes from time to time. This volume thus appears in fulfilment of that promise and will receive the same warm welcome accorded its predecessor, for it too will be of great value to all students and investigators in the very extensive field of synthetic organic chemistry.

The ten chapters included, with their authors and number of pages, are as follows: (1) Claisen Rearrangement (48 pp., D. Stanley Tarbell); (2) Preparation of Aliphatic Fluorine Compounds (45 pp., Albert L. Henne); (3) Cannizzaro Reaction (45 pp., T. A. Geissman); (4) Formation of Cyclic Ketones by Intramolecular Acylation (20 pp., William S. Johnson); (5) Reduction with Aluminum Alkoxides (The Meerwein-Ponndorf-Verley Reduction) (64 pp., A. L. Wilds); (6) Preparation of Unsymmetrical Biaryls by the Diazo Reaction and the Nitrosoacetylamine Reaction (46 pp., Werner E. Bachmann and Roger A. Hoffman); (7) Replacement of the Aromatic Primary Amino Group by Hydrogen (38 pp., Nathan Kornblum); (8) Periodic Acid Oxidation (79 pp., Ernest L. Jackson); (9) Resolution of Alcohols (35 pp., A. W. Ingersoll); (10) Preparation of Aromatic Arsonic and Arsinic Acids by the Bart, Bechamp, and Rosenmund Reactions (39 pp., Cliff S. Hamilton and Jack F. Morgan). The same admirable organization of the subject-matter of each chapter is followed as in Vol. I, with tables of contents, detailed lists of compounds to which the particular reaction has been applied and extensive references to the pertinent literature. In format, paper, binding and typography, it likewise resembles Vol. I.

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SPECIAL ARTICLES

ABNORMAL ALPHA KETOSTEROID EXCRETION IN PATIENTS WITH NEOPLASTIC DISEASE*

PREVIOUSLY reported results of studies made in this laboratory of the 17-ketosteroids extracted from individual urine collections of normal persons and those with leukemia, cancer, adrenal dysfunction and pregnancy, have demonstrated the marked variability in the nature and amounts of the substances excreted and have emphasized the importance of securing as full and detailed information as possible concerning the individual components.[1,2,3,4] In these investigations

* The authors gratefully acknowledge the assistance of the Jane Coffin Childs Fund for Medical Research, Commonwealth Fund, Williams-Waterman Fund, New York Foundation, Whiting Foundation, Felix M. and Frieda Schiff Warburg Foundation, Moses Rippa Fund, and Alfred P. Sloan Jr. Research Fund.

1 K. Dobriner, E. Gordon, C. P. Rhoads, S. Lieberman and L. F. Fieser, SCIENCE, 95: 534, 1942.

2 C. P. Rhoads, K. Dobriner, E. Gordon, L. F. Fieser and S. Lieberman, *Trans. Assoc. Am. Phys.*, lvii: 203, 1942.

3 K. Dobriner, third meeting, Conference on metabolic aspects of convalescence including bone and wound healing, Josiah Macy Jr. Foundation, 184, 1943. (Limited distribution).

4 S. Lieberman, B. R. Hill, L. F. Fieser, K. Dobriner, H. C. Taylor, Jr., and C. P. Rhoads, *Abstracts*, 107th Meeting, Am. Chem. Soc., Cleveland, April, 1944.

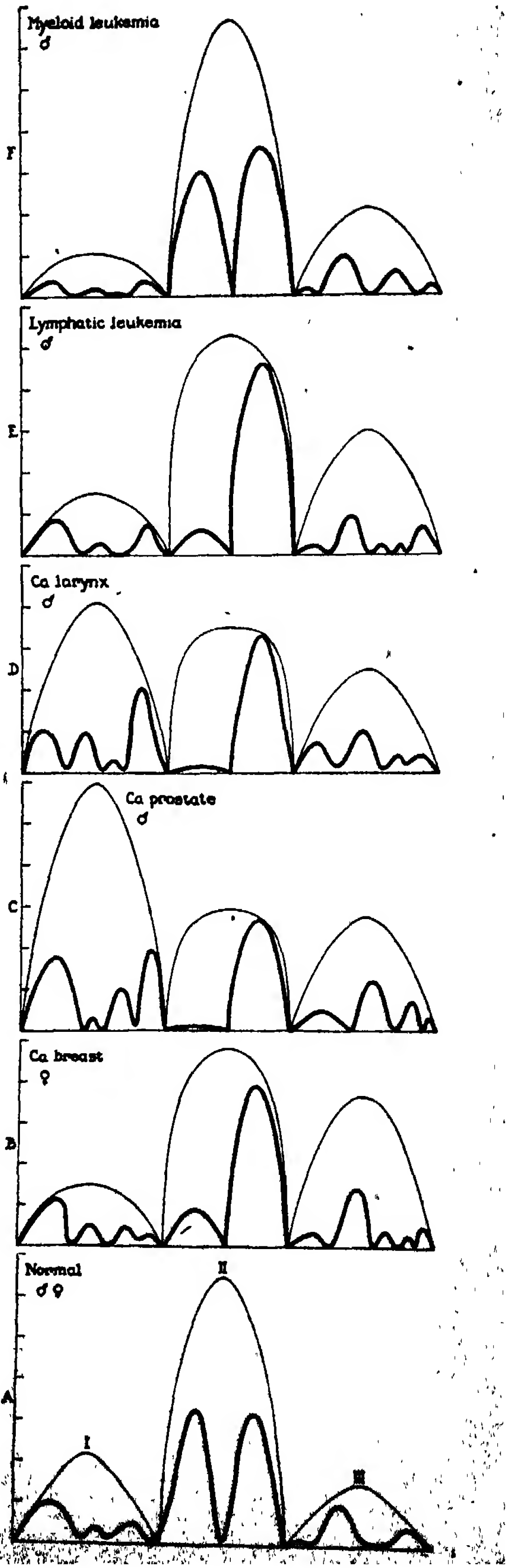
the alpha ketosteroid fraction of each urine has been fractionated systematically by extensive chromatographic adsorption analysis and the various crystalline products encountered have been purified and

TABLE I

Urinary Alpha Ketosteroids

Name or Melting Point of Compound	Formula	Group
248 - 252		
CHLORODEHYDROISOANDROSTERONE	$C_{19}H_{27}OCl$	
* $\Delta^{3,5}$-ANDROSTADIENONE-17	$C_{19}H_{26}O$	
135 - 136		
* Δ^{3}-ANDROSTENONE-17	$C_{19}H_{28}O$	
ALLOPREGNANDIONE-3,20	$C_{21}H_{32}O_2$	
* 117 - 118	$C_{21}H_{32}O_3$	
* 176 - 178	$C_{21}H_{32}O_3$	I
* 132 - 134		
117 - 121		
ALLOPREGNANOL-3α,ONE-20	$C_{21}H_{34}O_2$	
PREGNANOL-3α,ONE-20	$C_{21}H_{34}O_2$	
105 - 108		
120 - 125		
* ANDROSTERONE	$C_{19}H_{30}O_2$	II
* AETIOCHOLANOLONE	$C_{19}H_{30}O_2$	
145 - 148	$C_{21}H_{34}O_2$	
174 - 175	$C_{21}H_{32}O_3$	
* 188 - 189		
235 - 237		
185 - 186	$C_{21}H_{34}O_3$	
199 - 200	$C_{21}H_{32}O_3$	III
195 - 196	$C_{21}H_{34}O_3$	
192 - 194	$C_{21}H_{34}O_3$	
210 - 212	$C_{21}H_{34}O_3$	
230 - 233		
238 - 241		
201 - 204		
172 - 176		

characterized as fully as possible. The apparently homogeneous substances thus far isolated are listed in Table 1 in the order in which they are eluted They are divided arbitrarily into 3 groups The "early" or first group, consists of all the compounds which are eluted from an aluminum oxide chromatogram



before androsterone. The "middle," or second group, is made up of androsterone and aetiocholanolone; and the "late," or third group, includes all the compounds eluted after aetiocholanolone. Those substances which are obtained regularly from the urine of normal subjects are indicated by asterisks.

The total amounts of alpha ketosteroids present in each of these groups and also the amounts of the individual components were measured by the Callow procedure based upon the Zimmermann color reaction The results of the assays are represented graphically by the curves in the figure. The amounts of segregated fractions, expressed as the percentage of the total alpha ketosteroid content, are plotted on the ordinates. On the abscissae the principal substances listed in Table 1 are indicated from left to right in the order of their elution.

The percentage of the total alpha ketosteroid fraction made up by the compounds of the first or early group (I) is indicated by the height of the first peak of the light line; the parts represented by the middle (II) and late (III) fractions by the heights of the second and third peaks. The heavy-lined curves within each group represent the amounts of the individual components of that group.

A pattern of the alpha ketosteroid distribution in the urine of a normal person is given in the figure—A. Similar patterns were obtained from 5 normal men and 5 normal women. The curves resemble each other closely and differ only in minor details. The ratio of androsterone to aetiocholanolone (represented in the patterns as the two large, heavy-lined peaks in the middle group) is about 1:1 except in the case of older individuals.

The figure includes the patterns obtained from individual patients with lymphatic leukemia (E) and cancer (B, C, D). They are abnormal. A similarity is apparent between pattern E (lymphatic leukemia) and those from the patients with cancer. Pattern F obtained from a patient with myeloid leukemia shows only minor differences from the normal. The abnormality of the ketosteroid excretion by patients with cancer has been confirmed by the isolation from their urine of compounds so far not obtained from normal individuals or those with the non-neoplastic disorders investigated.

At present no conclusions can be drawn as to whether the abnormalities are specific for the particular disorders studied. The results indicate an abnormal function of the gonads, the adrenals or both, or possibly a disturbed metabolism of the products of these organs. A dysfunction of the adrenal cortex is suggested by the relatively large amounts of material isolated in the late or third fraction. In this fraction are found the highly oxygenated compounds which are assumed to be metabolites of the adrenal cortical hormones.

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THE NATURE OF MYASTHENIA GRAVIS[1]

In a recent communication Torda and Wolff[2] reported that the formation of acethylcholine (ACh) from incubated frog brain was significantly reduced in the presence of serum of patients with myasthenia gravis. They concluded from this finding that the defect in ACh synthesis in patients with myasthenia gravis probably explains the fatiguability and weakness of the patients.

A possible correlation between the thymus and myasthenia gravis is suggested by the frequent finding of thymic tumors in these patients. Recently it has been shown by Harvey and co-workers[3] that thymectomy in patients with myasthenia gravis eliminates certain differences between these patients and other individuals in the electro-myographic response to intra-arterial prostigmine injections.

On suggestion of Dr. Otto Loewi the synthesis of ACh from minced brain (after Quastel[4]) has been studied in the presence of thymic tissue obtained from a patient who died from myasthenia gravis and in the presence of serum from patients with myasthenia gravis.

Experiments: In order to be able to run controls from the brain of the same animal, rat brain (because of its larger size) seemed to us more suitable than frog brain. Fresh rat brain was minced in eserine Locke solution and the suspension divided with the pipette into four equal portions. Ground pieces of thymoma tissue were added to half of the samples. One sample with and one without thymoma was extracted immediately with hydrochloric acid, the other two were incubated at 37° and extracted after three hours. The total ACh contents of all the samples were then estimated on the frog rectus muscle.

In an attempt to confirm Torda and Wolff's findings rat brain was also incubated in the manner described above in the presence of serum of six patients with myasthenia gravis and in the presence of serum from

[1] From the Department of Pathology, Columbia University, College of Physicians and Surgeons, New York City.

[2] Torda and Wolff, SCIENCE, 98: 225, 1943.

[3] Harvey, Lilienthal and Talbot, *Jour. Clin. Invest.*, 21: 579, 1942.

[4] Quastel, Tennenbaum and Wheatly, *Biochem. Jour.*, 30: 1668, 1937.

control individuals. The ACh contents were determined before and after incubation. The findings are given in Fig. 1, where it is seen that no significant

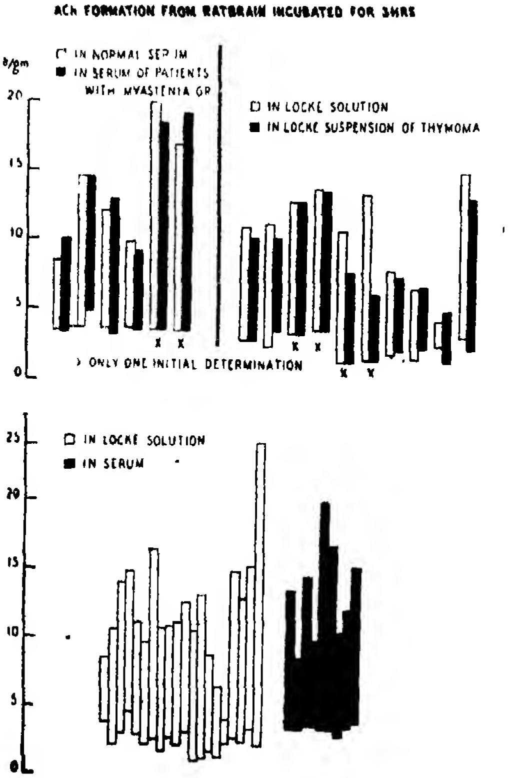

FIG. 1

differences in the amount of synthetized ACh were obtained regardless of whether or not thymus or serum from patients with myasthenia gravis were added to the medium. We also failed to observe significant differences between the amounts of ACh formed in Locke solution and in human serum. The latter findings are in contrast to Torda and Wolff's observations on frog brain.

HERBERT C. STOERK
ELVIRA MORPETH

ANTITYPHOID ACTIVITY OF Vi ANTIGEN FROM EXTRA-GENERIC SOURCES[1]

LONGFELLOW and Luippold[2] reported a high degree of immunity to large doses (10,000 to 1,000,000 MLD) of *E. typhosa* in mice immunized with vaccines prepared from the V-forms of Salmonella which, aside from their content of Vi antigen, were antigenically alien to the typhoid bacillus. Against such large challenging doses, vaccines prepared with the V-forms of *S. ballerup* and *S. coli* 5396/38 produced an immunity in mice against Vi strains of the typhoid organism which was quite as high as that produced by vaccines prepared in an identical manner with Vi strains of *E. typhosa*. It may be added here that the typhoid cultures used in these experiments and in the more recent investigations reported below consisted of pure V-form organisms, having been lyophilized as such and thereby maintained in their most active immunologic and pathogenic state.

It has recently been found that when mice were immunized with serial dilutions of *E. typhosa* and *S. coli* 5396/38 vaccines and subsequently challenged with small "invasive" doses (50 to 1,000 MLD) of typical Vi strains of *E. typhosa*, the *S. coli* 5396/38 vaccine proved to be significantly *more* effective. In short, *S. coli* 5396/38 vaccine produced a higher degree of immunity to *E. typhosa* than did *E. typhosa* vaccine itself. This anomalous result was obtained repeatedly, even when the typhoid vaccine and the challenging organisms were represented by the identical strain of the typhoid bacillus.

It is believed that this superiority of *S. coli* 5396/38 vaccine is a simple quantitative manifestation—that is, a manifestation of a greater quantity of Vi antigen on the V-form *S. coli* 5396/38 organisms than is present on the V-form typhoid bacilli. Some support of this assumption was obtained from dilute-HCl extracts of these two organisms; for, when these extracts, as cleared supernates, were inoculated into mice, there resulted an even greater dominance of *S. coli* 5396/38 over *E. typhosa* in antityphoid immunogenic potency. Just as, organism for organism, *S. coli* 5396/38 vaccine was the more effective, so was the quantity of available Vi antigen on this organism the greater.

In this way, it was found that the immunogen responsible for this immunity was easily removed from the organisms by solution in diluted HCl, from which it could be precipitated with acetone and recovered as a light-brown crystalline powder. Minute amounts of the latter (Vi extract) exhibited marked antityphoid immunogenicity as gauged by the potency of Wakeman's polysaccharide[3] and of Morgan's purified antigen[4].

In comparative mouse-immunization tests with alcohol-insoluble fractions of autolysates (Morgan) or tryptic digests (Wakeman) of the typhoid bacillus, this Vi extract from *S. coli* 5396/38 proved to be more potent per unit of dried material than the typhoid antigens cited above, when opposed by the lower invasive doses (100 to 1,000 MLD) of virulent typhoid organisms. When enormous challenging doses (10,000 to 1,000,000 MLD) of the test organism were given, the antigens prepared from autolysed or digested typhoid bacilli appeared to be somewhat more effective

[1] Preliminary report.
[2] D. Longfellow and G. F. Luippold, *Am. Jour. Hyg.*, [illegible], 1942.

[3] F. B. Wakeman, *Military Surgeon*, 84: 318–338, 452–471, 1939.
[4] H. R. Morgan, *Jour. Immunol.*, 46: 161–180, 1941.

than the Vi extract. The probable interpretation of these results is that the Vi extract possessed the capacity to produce superior anti-invasive immunity, while the typhoid antigens excelled in producing substances which neutralized the toxicity of large doses of bacterial protein—presumably because these typhoid antigens represented more completely the entire typhoid organism.

Although the Vi extract can be prepared from V-form typhoid organisms, the V-form of *S. coli* 5396/38 offers an appreciably more abundant source of this substance which, despite its extra-generic origin, possesses exceptional antityphoid immunogenic properties. Practical application of the use of this Vi extract—specifically as a fortifying agent in bacterial vaccines and in combination with conventionally prepared immunogens of the typhoid bacillus—are under consideration. Studies of its toxicity and stability and of its serological characteristics are now in progress and will be made the subjects of later detailed reports.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN APPARATUS FOR MEASURING THE TORSION ANGLE IN LONG BONES

RECENTLY, in a problem involving measurements of the degree of torsion existing in certain long bones of the extremities, it became necessary to construct a device for making such measurements Although this torsiometer was devised for use in a particular project, it might also find application in making other anthropometric measurements or in various studies requiring rather exact values for the degree of torsion or twisting of an object. The following is a description of the construction and use of the apparatus.

As shown in Fig. 1, the apparatus consists essentially of a 360° plastic protractor (A) and a pair of pointers (B), attached to a shaft (C) passing through the protractor's center. The protractor and shaft are mounted on a pivot (D) so that the shaft may be swung from side to side if necessary. To permit this swinging the support (E) must be triangular in cross-section, with the apex directed forward. The whole is mounted on a solid level base.

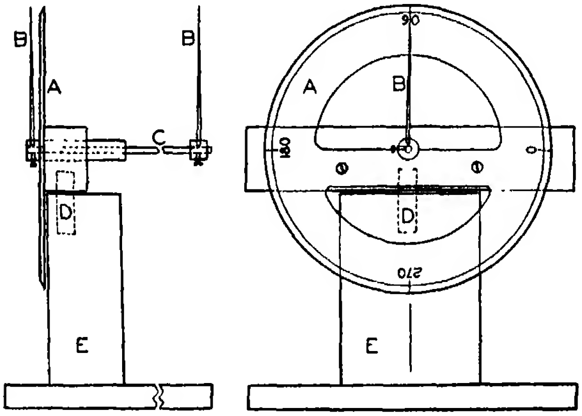

FIG. 1. Diagram of the torsiometer showing side and front views.

Shafts of various lengths may be used, depending upon the length of the object studied, or as in Fig. 1, the indicators may be threaded and screwed into tapped washers, the washers and indicators may then be moved along the shaft and fixed at the desired position with a set screw The shaft should be perfectly straight and should fit snugly in its bushing.

The size of all parts, of course, will be arbitrarily determined by the size of the object to be studied.

An ordinary ring stand and clamp will usually suffice to hold the object.

Before making a measurement, it is important to have both indicators in exact alignment. The bone (or other object) is clamped rigidly, parallel to the shaft with the long axis of the proximal epiphysis in line with the 90° radius of the protractor. The indicator at the free end of the rod is then turned until it is in line with the long axis of the distal extremity of the bone, and the protractor indicator moves with it. The number of degrees through which the shaft has turned is then read off directly on the protractor.

In cases where the object is not perfectly straight, but is curved to one side or the other, the protractor and shaft may be turned on the pivot until the rear indicator is in alignment with the distal end of the object.

This device has several points to recommend it. The parts are inexpensive and easily obtained. It is easily constructed and readings may be made directly, simply and rapidly.

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SLADEN, FRANK J. *Psychiatry and the War.* Pp. xxii + 505. Charles C Thomas. $5.00.

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THE LONG AND SHORT OF NUTRITION[1]

By Professor HENRY A. MATTILL

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MODERN nutrition was getting under way about the time of World War I; it is about as old as the science of aviation. The origins of both can be dated somewhat earlier, but in the intervening years of gradual development the few voices that were raised in high prophecy were drowned out by the derision of scoffers. Many of the classical nutritionists who had dealt with protein and calories snorted at the simple techniques of the new school as representing a bankruptcy of brains. "Anybody can feed animals, anybody can do vitamin work." It may be admitted that anybody could have done some of it, that some of it should perhaps not have been done by anybody, but to-day it stands justified. Not only has the "importance of little things" in the diet been revealed, but remarkable progress has been made in the understanding of how these little things work. With the growth of the concept of vitamins there have been amazing advances in the study of enzymes, some of which contain vitamin components in the molecule or require them as co-enzymes. Through the jungle of cellular oxidation trails are gradually being blazed; the uninitiated traveler can not yet readily find his way, but the paths are being cleared and markers and guide-posts are being placed. The new vantage points thus provided have suggested new approaches to the study of the metabolism of all the foodstuffs, in particular, of minerals and of protein.

Discoveries in physics, in theoretical and organic chemistry and the new techniques growing out of them have furnished new tools for the solution of old problems. They have also created new problems, and have raised more questions than they have answered. Levene[2] once said, "so long as life continues the human mind will create mysteries." But we can also

[1] From an address on the Annual Sigma Xi Day at the University of Rochester on February 22, 1944.

[2] P. A. Levene, SCIENCE, 74: 23, 1931.

subscribe to the faith which Sir Frederick Hopkins[3] expressed in his Harvard Tercentenary address, that "biochemical and physiological activities will in the end reach to a description of living systems which, in so far as they are chemical systems, will be complete."

If there is a "long" and a "short" to nutrition, the description of living systems in completeness is the "short" of it; the goals are almost in sight. The "long" of it will be the application of this knowledge, to the end that the human family shall be more adequately nourished. The reason why this is the "long" of it is that human beings are not merely chemical systems; superimposed are certain incommensurables, imponderables. Ignorance, prejudice and selfishness are among the causes of man's lack of an inward grace, as the prayerbooks say, and these three human attributes plus poverty which results from them are the principal barriers along the road to improved human nutrition.

That the nutrition of the common man, even in prosperous and enlightened North America, is in need of improvement requires no argument. The impact of the war worsened some of the conditions which make for malnutrition and shocked people out of a complacent unawareness. The schedule of recommended daily allowances set up by the National Research Council's Board of Food and Nutrition provided the first comprehensive set of tentative criteria by which dietaries can be assessed. We hear it said that malnutrition can not possibly be as wide-spread as some surveys have implied. A recent account[4] is certainly shocking enough, a study of 24 young married women in a housing project in the Southwest. Calorie intake was 1,145 per day, protein, calcium and phosphorus were also about half the recommended allowances, thiamin, niacin and riboflavin a little above a third. Family income, $13.50 weekly. This may be among the worst, but it can be duplicated elsewhere in the South and perhaps in the North. The exact proportion of undernourished people, whether it is one third, or more, of our population, is not the important item. The real question is why need any be undernourished in a country where surplus food has sometimes been destroyed.

In modern times the western hemisphere has not seen the spectre of famine, but when one includes Asia in his view one may properly ask the question: Can the world produce enough food to feed adequately every one living on it? This question has been answered both ways. Certainly the world as a whole has never had enough food nor could it have enough by to-morrow or by next year, but given ten years to reorganize agriculture and readjust distribution and consumption, perhaps it might. Britain's home production of food has increased from 40 per cent. to 65 per cent. of the requirements during the past three or four years. Our Bureau of Agricultural Economics in its analysis of crops, their cost per acre and per day of labor, used 29.5 bushels of corn per acre as the national average yield. In the upper Mississippi Valley, which is admittedly the bread-basket of the country, the yields of hybrid corn last season averaged over 100 bushels per acre, three times as much. And the Mississippi Valley still has meadows and woodland that are not used for crops.

They tell us[5] that in prewar days 100 acres of crop land in the United States of America fed 32 persons, in Denmark 58 persons, in Sweden 69, and in France 80; these figures are corrected for imports. No one who has ever lived in the country of the Danes or the Swedes will scoff at their food. The agriculture that provided it maintained the land in a high state of productivity by fertilizing, the crops were better cultivated, they were of a kind which require more labor, and thus labor as well as land went into food. More foods were grown for direct human consumption rather than first being converted into meat, dairy products and eggs; and finally the foods produced were utilized more fully. Under a national food policy backed by a planned agriculture, we could feed twice, three times, as many persons per acre of crop land as we are now doing. Even a famine-ridden country like India could approach adequate self-support in food if some of the labor of its millions were efficiently used to grow more food under national planning, on soil made available by irrigation or by the drainage of malarial swamps.

In the north porch of Bath Abbey there is a tablet commemorating Malthus, and as the verger points it out he bemoans the fact that the people of England spurned his teaching and instead followed the example of good Queen Victoria. Was Malthus right when he proclaimed that pestilence, war and famine and the vice and misery that attend them are the only checks upon an increase in population beyond the limits of the earth to support it? Pestilences are slowly being abolished or at least confined; our fighting men may unhappily bring us some of them from India's coral strands, but they will soon be brought under control. This war is to be the last war; it must not be allowed to happen again. And if we also abolish famine the last check on over-population is gone.

There is another horn to this dilemma. The idea of a pint of milk for every Hottentot has occasioned a good deal of raillery, some of it good-natured, some of it biting. Isn't it just possible that if we do not

[3] Sir F. Gowland Hopkins, SCIENCE, 84: 255, 1936.

[4] Jet C. Winters and Ruth E. Leslie, *Jour. Nutrition*, 26: 443, 1943.

[5] John D. Black, "Food Enough," Jaques Cattell Press, 1943, p. 122.

give them milk we will have to give them eggs (otherwise known as bombs)? The world has become so small that it can not long remain at peace if half the people are well fed, the rest ill-fed.

But granted that improved methods of production can greatly increase our own available food supply, with something to spare for the Hottentots, and granted that our standard of living can be maintained whatever our relations and commitments to the rest of the world, how can the rank and file of our citizens be assured of better nutrition? The answer is by education, a dual education in nutrition and in democracy.

In the opinion of many, the great efforts of the human mind manifest themselves much more frequently in times of war than in times of peace. As a nation we are becoming nutrition-conscious; the trend appeared before the war, but the movement for better nutrition has been accelerated by the presence of our fighting men in far-flung arctic and tropical regions, and all that this entails. Because of the mechanized character of this conflict, the nutritional status of industrial workers has attracted an attention that its shortcomings have long demanded. And finally, "food will win the war" in a sense quite beyond that in which the phrase was used three decades ago. Famine is even now stalking through Europe with a heavier tread than history records, and stable governments can not be established by starving nations.

People are always interested in their own health. A liberal thinker in the Protestant ministry once remarked that if he wanted to start a new religious cult or sect he would not fail to include a health clause in his creed; with this it would go over big. The old patent medicine business that still parades under other trappings is proof enough that people want to be well. What they need is enlightenment as to what they can do about it. Nutrition classes under various auspices have been supported with enthusiasm. The press carries some good material and even those who din into our ears the virtues of their vitamin tablets have added their bit. They have received two bits in return, for the American people are buying vitamin pills to the tune of more than 150 million dollars a year. Those who have participated in the development of the vitamin field may well stand aghast at such shameless prostitution of scientific knowledge, an abuse that is fully as reprehensible as the patent medicine game, except that people are getting a little something for their too much money. The real problem is to create an intelligent interest in good nutrition and in how to secure it. Good nutrition can not be achieved by adding a vitamin tablet to an inadequate diet poorly prepared. Man lives not by vitamins alone nor by 15 basic elements, count them. The easy way is not always the sure way.

Industry has lent a hand by improving the kind and quality of food served in factory restaurants and canteens and by providing something better than cokes and candy bars for a mid-morning snack. School lunches, if they are nutritious and well prepared, are heard about at home. Our food processing industries are also helping to spread the gospel of better nutrition; individually and in groups like the Nutrition Foundation, they are sponsoring worthy investigations in food and nutrition.

By and large, the medical profession is not yet making its proper contribution to the enterprise of nutritional education. Nutrition has too long been a stepchild in the medical family; the University of Rochester is a notable exception, as is well known. It is high time that medical students should be made aware of the impact of nutrition upon every aspect of medical practice. A pediatrician lately told me of a letter that came with a child being referred to him, in which the doctor said he did not think that the child's recurrent temperature was caused by the specific dynamic action of food.

Physicians are usually respected leaders in their communities; they can be influential citizens. The medical student should appreciate the fact that if he knows something about nutrition he will be listened to and will be consulted by his colleagues that know less than he does.

But one may say, no matter how well prepared the housewife is to feed her husband and children intelligently, she can not do it if the weekly pay envelope contains only 15 or 20 dollars. This question brings us to the consideration of a national nutrition policy which must embrace the entire economic problem of food production and distribution. Whether our democratic ship of state will embark on these vast and troubled waters remains to be seen, but that it should do so and can do so with some hope of reaching port is made plain by the little book to which reference has already been made.[5]

If we as a nation need education in nutrition and democracy the rationing program is a beginning in both. As compared with the recommendations of the National Research Council, the average estimated consumption per capita per day during the years 1936–1943 was entirely adequate, with the exception of riboflavin and the possible exception of niacin and calcium.[6] On the surface, this looks good, but the catch is that some people got more than their share and others got much less than their share. Rationing helps to relieve the pressure on price ceilings, but its principal function is to secure the distribution of food "more nearly in relation to need and thereby to obtain the greatest social return from the resources

[6] J. M. Cassels and Frances L. Hall, *Ann. Am. Acad. Polit. and Social Sci.*, 225: 106, 1943.

employed in its production."[6] Many Americans can tighten their belts without lessening their health and efficiency.

Even under rationing the lowest income group may still be restricted by limited purchasing power to quantities below the ration level. To allow them to buy as much as their ration cards allow, either their earnings must be supplemented or, as has been done in Great Britain, public restaurants and factory canteens must be established, provision made for school lunches and cheap milk. Food stamp plans might also do it.

The level of consumption in Great Britain since 1939 has been lower than ours, but thanks to excellent wartime food planning and rationing, the general nutritional status of the British people is now probably better than that of a large proportion of the lower-income families in this country. The effects of the war have been unbelievably tragic for the children of Europe, but in the opinion of Geoffrey Bourne,[7] with due allowance for all the disadvantages a child suffers from being brought up under war conditions, to the average British child it has been a benefit to live during the war. "Economic necessity is no longer a bar to obtaining milk, fruit, cod liver oil and other things that are needed for good health and growth. . . . After the war fullest use must be made of our new knowledge and experience on the subject of nutrition for maintaining and developing this improvement." In the words of Sir John Boyd Orr,[7] "priority in post-war planning should be given to the purchase and distribution by the state of basic foods in such quantities and at such prices as will put a health standard of nutrition within the reach of all."

It is doubtful that any measure of success in equable distribution of food can be attained without price control. Those who in 1918 had more than a physiological interest in food know what happened to food prices. The record of price control in the present war is open to all to read, and none are so blind as those who will not see. Too many favor price ceilings for every one but themselves.

Rationing and price control can not be completely effective unless production also is regulated and available supplies are brought into line with expected requirements. Rationing will probably not permanently be an acceptable feature of our national life, but we shall certainly be well advised if we insist on an intelligent system of control over distribution, prices and production for as long as may be necessary to avoid inflation and subsequent depression.

An enlightened democracy should be able so to order its affairs that production and distribution of food will insure every one enough to eat, and a reasonable profit to those concerned, without exploitation. The problem is complicated, but the greatest difficulties lie in man's inertia and in his short-sighted self-seeking. Desirable shifts in agricultural production, in methods of processing and in food habits, these will take time, but the time required to make the actual physical changes is less than that involved in the mental adjustments by which they must be conditioned.

Too many people who presume to speak authoritatively about these complex matters, especially in legislative halls, know too little about them. They should be told what the Irishman told his brother: "Drop that wheelbarrow! What do you know about machinery?" The necessary machinery is not as simple as a wheelbarrow. Also, too many people place private or political advantage before the public interest. There have been pressure groups ever since the caveman became a clansman. Recently in one of the Service Club publications there was a debate on butter *vs.* oleomargarine in which the butter-man said[8] that the reason for the maintenance of high license fees and a ten cent per pound tax on oleomargarine was to protect the consumer against the possibility of fraud. His powerful lobby has recently secured congressional action which continues this surcharge on a good and cheap food fat for those who can not afford to buy butter. The common man has no lobby.

Increased production of food is not enough. Twenty centuries ago a man who deeply desired to make a better world thought that more food might help; he even considered making stones into bread (which we can now figuratively do), but after further reflection he gave up the idea because he saw that moral integrity and not more food was what was needed to make a better world. "Nothing less wide than a system of planetary ethics will suffice in so small a world as this."[9]

What can we as individuals do in this matter? As citizens we can keep as widely informed as possible; we can join with others to hold up the arms of our enlightened public servants, and by letter and ballot we can reproach those who support entrenched neo-fascist minorities. The "common man" should also not escape condemnation when he seeks selfish advantage; in a final analysis this war is only another convulsive episode in his struggle with those in every land who are trying to forge the shackles of a new feudalism. To be worthy of democracy the common man too must learn that freedom can not exist without social responsibility.

As teachers and investigators we must cultivate

[7] Editorial quotation, *Manchester Guardian Weekly*, 50: 15, 1944.

[8] John Brandt, *The Rotarian*, 64: 35, 1944.

[9] E. G. Conklin, "Man: Real and Ideal," Scribners, 1943, p. 195.

unprejudiced objective thinking in ourselves and in our students. We must emphasize the human side of science and its intellectual and social implications.

Since time began poets and seers have dreamed of a far-off divine event, toward which the whole creation moves. When that event does appear, better nutrition, as one of the fruits of real democracy, will have helped to ring in the thousand years of peace.

OBITUARY

HENRY ANDREW BUEHLER

IN the death of Henry Andrew Buehler, "The Chief," on March 14, 1944, the geological profession lost one of its older and most respected and honored members. His loss is one which will be most directly felt in Missouri, the State of his adoption, but will also be sensed throughout the mining world.

Buehler was born at Monroe, Wis., on May 27, 1876. He received the degree of bachelor of science in chemical engineering in 1901 at the University of Wisconsin. In 1925 the honorary degree of doctor of science was bestowed upon him by the Missouri School of Mines and Metallurgy of the University of Missouri. While in the University of Wisconsin he became acquainted and associated with E. R. Buckley, then state geologist of Wisconsin. When Buckley became state geologist of Missouri, Buehler became his assistant immediately after his graduation from college.

With the exception of one year (1907–08) when he was employed by the Federal Lead Company, Mo., he remained a servant of the State of Missouri throughout the remainder of his life. In 1908 Governor Joseph W. Folk appointed him state geologist of Missouri. The wisdom of this appointment and the service of the "Chief" is best exemplified by the fact that he was reappointed by each of nine succeeding governors. Few people knew his politics—no one cared. He was accepted as being above party lines.

Buehler's publications numbered thirty-four. The larger portion of these were "Biennial Reports of the State Geologist to the Missouri General Assemblies." His unselfish attitude toward his fellow employees and associates resulted in the publication of many of his ideas and theories by these associates. He thoroughly enjoyed and glorified in the inoculation of an associate with an idea and seeing it culminate in a research paper. Had he taken the selfish position of publishing the results of his research and direction, his bibliography would have been several times thirty-four. His early work as a geologist under Buckley left to the State of Missouri and the geological profession three reports that are still in demand; these are "The Quarrying Industry of Missouri," "The Geology of the Granby Area, Mo." and "The Lime and Cement Resources of Missouri." The first publication to be released under his direction as State G[illegible] Missouri was the masterly treatise by [illegible]aster and predecessor, E. R. Buckley, "The Geology of the Disseminated Lead Deposits of St. Francois and Washington Counties, Missouri," 1908. The last publication released under his supervision was by his assistant, H. S. McQueen, "The Fire Clay Districts of East Central Missouri," 1943. Truly did the "Chief" administer and direct in preference to research and the accumulation of a large bibliography.

Buehler was creative and progressive. He never stopped planning and initiating new fields of research. The appropriations he obtained were always inadequate, but he made the most of them by cooperative programs with the U. S. Geological Survey. He early recognized the necessity for detailed topographic quadrangles and spirit leveling. This made it possible to complete a reconnaissance gravity survey of Missouri, which was recently published as a gravimetric map of the state. He believed in the use of all available methods of geological exploration and saw the completion of the magnetic survey of Missouri. The surface waters of the State were believed by him to be a part of its natural resources. An extensive cooperative program has resulted in the accumulation of valuable data on the discharge of all major streams and rivers in Missouri. The Cambro Ordovician formations of the Ozarks were difficult to identify in cuttings obtained from drilled wells. At his suggestion a study was made of the insoluble residues from these formations. These residues were found to be sufficiently diagnostic to permit the identification of each formation. This principle has been well received and his laboratories became the mecca for geologists faced with this problem.

While being progressive and ever willing to test new theories and practices, Buehler was erroneously considered by some to be a conservative. Any semblance of conservatism on his part was due to the inadequacy of information presented with a new concept. If the facts established the concept, he accepted it regardless of how revolutionary it might have been. He was a firm and staunch supporter of E. O. Ulrich's "Ozarkian Period." He believed his friend Ulrich knew better than any geologist the formations assigned to this highly controversial group of rocks. He likewise believed the deposition of the lead and zinc sulfides in the Ozarks was due to the downward circulation of cold meteoric waters. He was never convinced that sufficient evidence had been presented to explain these

deposits by ascending magmatic waters. If the advocates of the latter theory had presented conclusive evidence to support their belief, he would have been among the first to accept it.

Every mineral industry in the State of Missouri felt the wisdom and influence of Buehler. His advice and counsel was in constant demand. Requests for information about mineral resources were given his personal attention. No task was too great if it involved the greater utilization of the mineral wealth of his State. The fruit of his life-long service and industry is testified by the fact that Missouri's mineral production in 1901 was less than $15,000,000, whereas in 1943 it approximated $75,000,000. There have been times when he was accused by promoters to be retarding the development of these resources because he would not recommend to the Missouri Securities Commission the authorization of the sale of stock on certain promotional programs.

Buehler could have used the services of a press agent. His modesty would not permit the publicity which was merited by his department. He enjoyed expressions of praise and appreciation of services rendered, but he wanted these praises spoken in a semi-private environment. He was sublimely happy when he was showing fellow geologists the interesting phenomena of his State. Frequently he directed extensive field conferences with more than 100 geologists in the party. On these occasions there were not enough hours in the day to satisfy him.

There was no man in the state of Missouri whose wisdom and counsel were in greater demand. A fellow state geologist has written: "I do not know of any of our fellow members (Association of American State Geologists) who has been more prominent in service to our states or occupied a higher place in the councils of the state government." He was a member *ex-officio* of the Missouri State Highway Commission; a member of the Missouri Planning Commission; the Missouri Resources Museum Commission; the State Commission of the New York World Fair of 1939 and the Golden Gate Exposition of 1939. At the time of his death he was in Jefferson City attending meetings of the Missouri Commission of Resources and Development and the Missouri State Highway Commission. In 1934–35 he was state engineer on the Civil Works Administration.

Dr. Buehler was a fellow of the Geological Society of America. He was an active member of the American Institute of Mining Engineers, serving as president in 1935. He was also a member of the American Association of State Geologists, the Society of Economic Geologists, The American Association for the Advancement of Science, the American Association of Petroleum Geologists, the Missouri Academy of Science, the Wisconsin Academy of Science, Arts and Letters, the National Research Council, the Highway Research Board, the State Historical Society of Missouri, Sigma Xi, Tau Beta Pi and Theta Tau.

Buehler was never married. He spread his devotion and affection on under-privileged children, civic enterprises and worthy students of the Missouri School of Mines and Metallurgy. The latter he referred to as "his boys" and he took great pride in watching them develop into leaders in the fields of mining and industry. The financial assistance he gave to "his boys" was in reality only a small part of their rich inheritance. The wisdom of his counsel, the devotion to his profession and the soundness of his philosophy of life were inspirational. He was a great teacher and minister although he refused to admit it.

Buehler was richly endowed with qualities that endeared him to all who knew him. His colorful and strong personality, straight thinking, utter frankness, genial friendliness, rough humor, code of ethics, originality, initiativeness and untiring devotion to assigned duties made him a man whose character, honesty and integrity were ever beyond reproach. His work is over, but his presence will continue to be felt.

EDWARD L. CLARK,
State Geologist of Missouri

OSCAR MILTON STEWART

OSCAR MILTON STEWART, who died in Columbia, Mo., on May 17, 1944, was one of the most widely known and esteemed American physicists of the passing generation.

His father was a Methodist minister. It has always been the policy of that denomination not to allow its preachers to stay very long at one point, and in that way it happened that the children of the family were mostly born in different places. Oscar's birth occurred at Neosho, Mo., on November 3, 1869. He attended DePauw University, where he took the degree Ph.B.; and later he went to Cornell University, where he received his Ph.D. in 1897. Years later, in 1938, DePauw gave him the honorary degree of D.Sc.

He was kept at Cornell University as instructor from 1898 till 1901, when he was appointed assistant professor of physics at the University of Missouri, which was then being radically improved under President Jesse. Shortly after 1901 he was made professor, though in fact he directed the affairs of the department for practically all the thirty-nine-year period preceding 1940.

In 1899 he married Miss Estelle Williams, of Ithaca. The couple had only one child, Lawrence. It was their misfortune to lose him in his early manhood. He was an early victim of the influenza epidemic of the first World War, at the Great Lakes Training Center. The

loss of this son was a severe blow, particularly to Mrs. Stewart, who never seemed in good health thereafter. She died shortly before the retirement of her husband, which occurred in 1940.

About the same time, Dr. Stewart's advancing age brought on vascular and cardiac troubles. He underwent one cerebral hemorrhage in 1941, and one or two more later. During the past eight months about one third of the time was spent in a hospital.

He published a number of research articles of value, but he was primarily a very successful teacher. His principal interests were in the philosophy and logic of physical science, but he also took a keen interest in practical applications. He had been a member of the American Physical Society since its organization, or nearly so, and a fellow for many years; also fellow of the A.A.A.S. and member of the Society for the Promotion of Engineering Education, Phi Beta Kappa, Sigma Xi, Tau Beta Pi and the social fraternity, Phi Kappa Psi. His college text-book of physics has been remarkably successful, and is one of the most carefully edited texts the present writer knows. He was also co-author of a successful high-school text.

In 1911 he collaborated with the firm of architects, Jamieson and Spearl, in designing the present Physics Building, which is probably the best-planned and best-constructed building on the campus.

Stewart was an excellent business man, and his personal fortune at the time of his death was considerable. His will leaves the bulk of the estate to the University of Missouri, with the stipulation that the interest shall be used for the benefit of the Department of Physics. Some latitude is permitted in the expenditure, but his expressed intention was that it should be used largely for scholarships to graduate or undergraduate students working in physics or for lectures by visiting physicists. This will no doubt be a fund of great value to the department.

Only two members of the original family survive. They are a brother, G. W. Stewart, who is well known to the physics fraternity as professor at the University of Iowa, and a sister, Mrs. E. L. Morgan, of Chesterton, Ind. Mrs. Morgan has been so kind as to give her deceased brother's considerable library to the department.

Professor Stewart's character was notable for a very high degree of modesty and almost limitless patience. He had many warm friends among the older group of physicists in the country as well as former students at Missouri. Those of us who have had the privilege of working with him for many years regret his passing very much indeed.

H. M. REESE

RECENT DEATHS

DR. LEONARD WHEELER ELY, since 1923 until his retirement with the title emeritus in 1934 professor of surgery at Stanford University, died on June 17. He was seventy-five years old.

DR. ROBERT A. HALL, chemist of the Colgate-Palmolive-Peet Company, died on June 16 at the age of fifty-eight years.

DR. HORACE CHAMBERLAIN PORTER, consulting chemical engineer of Philadelphia, died on June 15 in his sixty-eighth year.

SCIENTIFIC EVENTS

INDUSTRIAL RESEARCH COMMITTEE OF THE FEDERATION OF BRITISH INDUSTRIES[1]

THE Federation of British Industries has decided to strengthen its organization on the research side by making its Industrial Research Committee a permanent standing committee of the federation, with its own secretariat. By its terms of reference this committee will seek to stimulate national interest in research for industry and foster it in all appropriate ways. Thus it will encourage industrialists to devote a more adequate part of their resources to the promotion of research and its application to existing products and to the development of new products. It will provide money for the creation and maintenance of adequate facilities for postgraduate research; and encourage the education of the necessary research and development staff of universities, technical colleges and industrial establishments. The committee will promote contact and collaboration wherever possible between centers of industrial research or institutions and research workers; and facilitate cooperative research within British industry, with special reference to the needs of small-scale industries. Information on research questions will be provided by creating a liaison with appropriate reference libraries and technical and scientific institutions; and attention directed to the publications of professional, technical and scientific institutions, assistance being given where necessary in their distribution. The committee will promote the compilation of general information on industrial research, particulars of organizations and the facilities available; and provide from time to time information for press and public on the achievements of British industrial research.

[1] From *Nature*.

STANDARDS FOR PHOTOGRAPHIC CINEMATOGRAPHIC EQUIPMENT

A COMMITTEE of the American Standards Association to develop standards for important photographic and cinematographic equipment used by the armed forces, has been set up by the association at the request of the War Production Board on the initiative of the Army Pictorial Service. It includes representatives of the Signal Corps, Air Force, the Photographic Section of the Bureau of Aeronautics of the U. S. Navy, the Engineers Corps, the Marine Corps and manufacturers of photographic and cinematographic equipment. The Society of Motion Picture Engineers is represented, and the Research Council of the Academy of Motion Picture Arts and Sciences is being invited to appoint a representative.

R. B. Shepard, of the War Production Board, has been appointed chairman of the new committee. J. W. McNair, of the staff of the association, serves as secretary.

Following recommendations of the Armed Forces Committee under the chairmanship of Captain Lloyd Goldsmith, of the Army Pictorial Service, a number of projects has been undertaken. Probably the most important of these is development of a specification for a service model 16mm sound film projector.

The committee has made definite assignment of all projects requested by the Armed Forces to task committees, instructed to proceed with the utmost speed in the development of the specifications.

The projects include the following developments:

A standard specification for slide-film projectors, to include both manually and electrically operated projectors for 35mm slide-film and 2 × 2 inch slides.

A standard specification for measuring the performance characteristics of still camera shutters.

A standard performance specification including characteristics and methods of test for photographic exposure meters.

A performance and test specification for still picture contact printers.

A specification for 16mm motion picture test films.

A specification for standards of quality and control of processing and printing 16mm film.

A specification for the size and shape of 16mm and 35mm picture apertures of optical reduction printers and 16mm contact printers.

A specification for the size and shape of the photographic apertures of 16mm and 35mm motion picture cameras.

A specification for the size and shape of 16mm and 35mm motion picture camera view finder apertures.

A specification for a standard registration distance for 16mm and 35mm camera lenses.

A specification for a 35mm motion picture camera drive motor to operate from either 12 or 24 volts D.C. both of which voltages are used by the services.

A specification for camera noise measurements and acceptable limits for 16mm and 35mm sound motion picture cameras, sizes that are widely used in civilian life as well as by the services.

A performance specification for 16mm portable projection screen.

FELLOWSHIPS OF THE NATIONAL FOUNDATION FOR INFANTILE PARALYSIS

THE National Foundation for Infantile Paralysis has set aside the sum of $50,000 for fellowships in health education. Under this program, which has been developed in cooperation with the U. S. Public Health Service, qualified men and women will go into training beginning with this autumn.

Candidates for the fellowships will be selected by an advisory committee of the U. S. Public Health Service, and those accepted will be assigned to the schools of public health of Yale University, the University of Michigan and the University of North Carolina.

A bachelor of science degree, or its equivalent from a recognized college or university, is an essential qualification for one of these fellowships leading to the master of science degree in public health. Training will consist of nine months' academic work, followed by three months of supervised field experience.

Women between the ages of nineteen and forty who have the above educational qualifications and who are citizens of the United States are eligible. Men who are citizens over thirty years of age also may apply, and the War Manpower Commission has declared Selective Service registrants in 4F and 1AL classifications as eligible for these fellowships.

The fellowship provides a stipend of $100 monthly for twelve months, tuition and university fees to the school and expenses for field service. Applications can be obtained from the Office of the Surgeon General, U. S. Public Health Service, Washington 14, D. C. Applications must be accompanied by a transcript of college credits and a small photograph, and must be in the Office of the Surgeon General not later than August 15.

THE GIBSON ISLAND CONFERENCE ON CANCER

THE final program of the Conference on Cancer to be held at Gibson Island, Md., under the auspices of Section C of the American Association for the Advancement of Science, is as follows:

July 31

Albert Claude: Topography of Cell Function.

E. W. Shrigley and Francisco Duran-Reynals: The Biology of Virus-induced Tumors.

Alfred Taylor: Virus Production of Mammalian Tumors.

W. Ray Bryan and H. Kahler: Virus Studies with Newer Techniques.

August 1

John J. Bittner: Inciting Influences in the Etiology of Mammary Cancer in Mice.

H. B. Andervont: The Milk Factor in Breast Cancer in Mice.

Mary E. Maver: Serology of Tumor Cathepsins.

Jacob Furth: The Site and Time of Malignant Change in Leukemia of Mice.

August 2

F. H. J. Figge: The Relationship of Pyrrole Compounds to Carcinogenesis.

L. F. Fieser: Discussion of Hydrocarbon Carcinogenesis.

W. R. Earle: Production of Malignancy in Vitro.

Harry S. N. Greene: The Occurrence of Dependent and Autonomous Phases in the Development of Cancer.

August 3

R. J. Williams: B Vitamins and Cancer.

J. P. Greenstein: Enzymes and Cancer.

H. P. Rusch and C. A. Baumann: The Prevention of Experimntal Liver Tumors by Dietary Means.

August 4

Heron O. Singher: The Effect of Inhibitory Agents on Normal and Malignant Tissues.

Curtis Flory and Jacob Furth: Chemotherapeutic Studies on Leukemia.

The registration limit of seventy participants has now been reached. Further applications[1] must be taken on a waiting-list basis, in anticipation of possible cancellations. It is planned, however, to publish promptly the great majority of the papers as a special monograph in the series of symposium publications issued by the American Association for the Advancement of Science, similar to the earlier "Some Fundamental Aspects of the Cancer Problem" (Occasional Papers, No. 4, 1937). The monograph will also contain a record of the discussion, which will be taken down for the first time at these conferences. Funds for stenotyping have been provided for by a grant from the Jane Coffin Childs Memorial Fund. Additional written comments which the participants may care to submit will also be included. It is intended that the reports, papers, discussions and submitted comments will emphasize, so far as possible, the frontiers of investigation and the most recent experimental information available on the aspects of cancer considered.

DEAN BURK, *Chairman*
RALPH G. MEADER, *Vice-Chairman*

[1] For preliminary announcement, with details of registration, see *Chem. and Eng. News*, 22: 109, 1944

SCIENTIFIC NOTES AND NEWS

DR. ALBERTO RECIO, Minister of Public Health of Cuba, has announced the opening on May 17 of the National Institute of Hygiene in Havana. On this occasion President Batista presented decorations of the order of Carlos J. Finlay to Brigadier General James S. Simmons, director of preventive medicine, Surgeon General's Office, U. S. Army; Colonel Harry Plotz, chief of the Division of Virus and Rickettsial Diseases, Army Medical School, Washington, D. C.; Dr. Rolla E. Dyer, director of the National Institute of Health, Bethesda, Md.; Dr. Reuben Kahn, of the University of Michigan; Dr. Henry Hanson, Commissioner of Health, Florida, and Dr. A. A. Moll, executive secretary of the Pan American Sanitary Bureau, Washington, D. C. At the same time the Cuban Government presented decorations to the Rockefeller Foundation, the American Public Health Association and a posthumous award to the American Yellow Fever Commission in honor of the great services rendered to yellow fever control.

DR. LILLIAN M. GILBRETH and Dr. Frank B. Gilbreth (posthumously) have been awarded the Henry Laurence Gantt Memorial Gold Medal for 1944 of the American Society of Mechanical Engineers "in recognition of their pioneer work in management, their development of the principles and techniques of motion study, their application of those techniques in industry, agriculture and the home, and their work in spreading that knowledge through courses of training and classes at universities." The medal is administered by the Gantt Medal Board of Award consisting of representatives of the American Society of Mechanical Engineers and the American Management Association.

THE Squibb Award of the Association for the Study of Internal Secretions was presented at the Chicago meeting on June 12 to Dr. Edward A. Doisy, professor and director of the department of biochemistry of the School of Medicine of St. Louis University, for his "contributions to scientific knowledge, particularly in endocrinology." The first award of the Ciba Pharmaceutical Company was presented to Dr. Edwin B. Astwood, assistant professor of pharmacotherapy at the Harvard Medical School, "for his contributions in the field of sex hormones and on the thyroid gland."

DR. HAROLD HENRY BEVERAGE, vice-president in charge of research and development of the Radio Corporation of America, has received a certificate of appreciation from the U. S. Army Signal Corps for his work in connection with the installation of a radio-teletype circuit in the North Atlantic. Major General H. C. Ingles, chief signal officer, made the presentation.

At the commencement on June 24 of Bowdoin College the degree of doctor of science was conferred on Dr. Cornelius P. Rhoads, director of Memorial Hospital for the Treatment of Cancer and Allied Diseases, New York City.

Citations as distinguished alumni were awarded on June 10 by the University of Chicago to Dr. Ralph W. Chaney, professor of paleontology, and to Dr. Leonard B. Loeb, professor of physics, both of the University of California at Berkeley.

Dr. Sanford B. Hooker, of the School of Medicine of Boston University and the Evans Memorial Hospital, was the guest of honor at the first annual meeting of the American College of Allergists which was held in Chicago on June 10 and 11. The subject of his address was "Qualitative Differences in Canine Dander."

Dr. Alfred L. Nelson, chairman of the department of mathematics of Wayne University, Detroit, has been elected president of the Michigan Academy of Science, Arts and Letters.

The honorary fellowship of the Royal College of Obstetricians and Gynecologists has been conferred on Sir Joseph Barcroft, until his retirement in 1937 professor of physiology at the University of Cambridge.

Dr. Roger Irving Lee, practising physician of Boston, formerly professor of hygiene at the Harvard Medical School, was elected at the Chicago meeting president of the American Medical Association for the period 1945–1946.

Officers of the American Society of Naturalists, elected by mail ballot, are: *President,* Dr. Fay Cooper Cole, Anthropology, University of Chicago; *Vice-president,* Dr. Charles W. Metz, Zoology, University of Pennsylvania; *Secretary,* Dr. Wm. Randolph Taylor, Botany, University of Michigan; *Treasurer,* Dr. M. R. Irwin, Genetics, University of Wisconsin (continuing); *Editorial Board, The American Naturalist,* Dr. Leon J. Cole, Dr. A. Franklin Shull and Dr. Laurence H. Snyder. The annual meeting will be held at Cleveland from September 12 to 24 in conjunction with the meeting of the American Association for the Advancement of Science.

Dr. Paul E. Klopsteg, formerly president of the Central Scientific Company of Chicago, who for the past two years has been chief of the Division of Physics of the National Defense Research Committee and assistant chief of the Division of Field Service of the Office of Scientific Research and Development, has been appointed director of research and professor of applied science to direct advanced studies and the coordination of research in the post-war period in the Technological Institute of Northwestern University. Dr. Klopsteg was a member of a committee, of which Dr. Charles F. Kettering was chairman, to advise the institute on post-war development.

Dr. Wm. H. Emmons, who since 1911 has been chairman of the department of geology of the University of Minnesota and head of the State Geological Survey, and Dr. C. R. Stauffer, paleontologist, since 1917 professor of geology at the university, are retiring at the close of the academic year. Dr. Geo. A. Thiel has been appointed chairman of the department and Dr. F. F. Grout has become director of the Minnesota Geological Survey.

Dr. William Walter Greulich, professor of physical anthropology and anatomy and director of the Brush Foundation at Western Reserve University, has been appointed professor of anatomy at Stanford University.

Dr. George F. Papenfuss, research associate in botany at the University of California at Berkeley, has been appointed, effective in July, assistant professor of botany.

Dr. Frederic A. Gibbs, of the Harvard Medical School, has been appointed associate professor in the department of psychiatry of the Illinois Neuropsychiatric Institute of the College of Medicine of the University of Illinois, effective on September 1. Mrs. Frederic A. Gibbs has been appointed research assistant at the same institution.

Dr. Charles Maurice Yonge, professor of zoology at the University of Bristol, has been appointed regius professor at the University of Glasgow. He succeeds Professor E. Hindle, who has become scientific director of the Zoological Society of London.

Dr. John A. Farrell has been appointed medical director of the John and Mary R. Markle Foundation.

Dr. Kenneth H. Doan, research associate at the Franz Theodore Stone Laboratory of the Ohio State University, has become associate biologist with the Fisheries Research Board of Canada.

Dr. Richard H. Barnes, until recently assistant professor of physiological chemistry at the Medical School of the University of Minnesota, has been appointed head of the Department of Biochemical Research of Sharp and Dohme, Glenolden, Pa. He succeeds Dr. L. Earle Arnow, who was recently appointed director of research.

Dr. Clarence Cottam, biologist of the Fish and Wildlife Service of the U. S. Department of the Interior in charge of the section devoted to research on economic wildlife problems, has been appointed assistant to the director. He will serve as a coordinating and liaison officer in the field of wildlife conser-

vation and management in connection with other land-use agencies, particularly the Bureau of Reclamation, the Army Engineers of the War Department, the Tennessee Valley Authority and other Federal and State agencies.

Dr. Morris A. Stewart, associate professor of parasitology at the University of California at Berkeley, is leaving to spend three months in Bolivia. He will have his headquarters in Santa Cruz, but will travel to remote parts of the country. His report on parasitic diseases and means for their control will be used by the Bolivian Government in its program for the economic development of the country. Dr. Stewart also will visit research laboratories in parasitic diseases in Mexico and the hospital devoted to the study of tropical diseases in Guatemala City. He will advise with the anti-plague service in Peru and will give lectures on malaria in Colombia.

The Royal Caroline Institute, Stockholm, which is in charge of the Nobel Fund for Medicine, has decided to build a Medical Nobel Institute for research in anatomy, biochemistry and physiology. The new institute, according to *Nature*, will consist of three departments in one building to be erected on the premises of the new medical center at Norrbacka in the northwest region of the city. The Biochemical Nobel Institute was founded in 1937 and is directed by Professor Hugo Theorell. The physiological department will be a Neurophysiological Research Laboratory privately endowed in 1940 for Professor Ragnar Granit, who will also be in charge of the new institute. The anatomical department will be associated with a new chair in cell research to be founded for Dr. Torbjörn Caspersson.

The Thomas W. Salmon Lectures for 1944 will be given in November at the New York Academy of Medicine by Brigadier John R. Rees, consultant psychiatrist to the British Army. His subject will be "The Shaping of Psychiatry by War."

Dr. Hudson Hoagland, executive director of the Worcester Foundation for Experimental Biology, gave the address at the spring initiation meeting of the Chapter of the Society of the Sigma Xi of the Worcester Polytechnic Institute. The title of the lecture was "Adventures in Biological Engineering."

Dr. Louis S. Goodman, professor of pharmacology and physiology at the College of Medicine of the University of Vermont at Burlington, delivered on May 17 the annual Alpha Omega Alpha lecture of the College of Medicine of Syracuse University. He spoke on "Some Aspects of Recent Advances in Pharmacology."

The Society for the Promotion of Engineering Education opened its fifty-second annual meeting on June 23 at the University of Cincinnati.

A unit of the Medical Research Council for research in applied psychology has been set up in the psychological laboratory of the University of Cambridge, of which Dr. F. C. Bartlett is the head. Dr. K. J. W. Craik has been appointed to the staff of the council as director of the unit. Members of the unit will undertake work elsewhere than at Cambridge, including investigations for the Industrial Health Research Board of the council.

It is stated in *Nature* that the Rockefeller Foundation has made a grant of 15,000 rupees to the National Institute of Sciences of India, to give assistance in the publication of scientific papers in Indian journals. This grant is similar in character to that which has been made annually for some years by the foundation to the Royal Society to assist in the publication of scientific papers in Great Britain.

A wireless to *The New York Times* states that, according to Professor Ugo Papi, general secretary, all property, including the archives of the International Institute of Agriculture at Rome, is safe. The German authorities did not deprive the institute of its diplomatic immunity, enjoyed since its founding in 1905 "for the protection of the common interests of farmers and for the betterment of their conditions after preliminary study of all requisite sources of information." During the enemy occupation the institute was allowed to continue as in peace time and representatives of principal nations at war against the Axis went on with their research unmolested. Since the Allied entry into Rome such of the institute's personnel as belong to enemy nations likewise have been respected.

The *News Bulletin* of the Institute of International Education reports that the Pan American School of Agriculture, established recently at Zamorano, Honduras, for the study of scientific agriculture as applied to Central American conditions, has ended its first period of work with an enrolment of seventy-four students from five Central American republics It was expected that the second session, which opened on June 1, the enrolment and the countries represented would show a considerable increase. The school is some twenty miles from the capital of Honduras and comprises 1,416 hectars of land in the valley of El Zamorano. The site was chosen after a careful consideration of its altitude, climate, irrigation facilities, quality of soil and other elements. The present agricultural course is for three years. Agricultural engineering is to be added to the curriculum later.

DISCUSSION

NOMENCLATURE OF THE RH BLOOD TYPES[1]

BASED on recent developments in the knowledge of the Rh blood types, certain changes in the nomenclature originally proposed by the writer[2,3] for the Rh agglutinogens and agglutinins appear desirable.

TABLE 1

ORIGINAL NOMENCLATURE OF THE RH TYPES AND THEIR DISTRIBUTION AMONG 871 WHITE INDIVIDUALS IN NEW YORK CITY

Classes	Reactions with antisera			Types		Reactions with antisera			Types	
	Anti-Rh*	Anti-Rh_1†	Anti-Rh_2‡	Designation	Frequencies per cent.	Anti-Rh	Anti-Rh_1	Anti-Rh_2	Designation	Frequencies per cent.
W	–	–	–	Rh negative	12.4	+	–	–	Rh	2.5
U	–	+	–	Rh′	0.8	+	+	–	Rh_1	53.6
V	–	–	+	Rh″	0.5	+	–	+	Rh_2	13.4
UV	–	+	+	Rh′Rh″	...	+	+	+	Rh_1Rh_2	16.8

* Standard anti-Rh agglutinin; corresponds with the original anti-rhesus serum of Landsteiner and Wiener, and gives about 85 per cent. positive reactions on bloods from white individuals (K. Landsteiner and A. S. Wiener, *Proc. Soc. Exp. Biol. and Med.*, 43: 223, 1940).

† Agglutinin anti-Rh_1 gives approximately 70 per cent. positive reactions on Whites (A. S. Wiener, *Arch. Path.*, 32: 229, 1941).

‡ Agglutinin anti-Rh_2 gives approximately 30 per cent. positive reactions on Whites (A. S. Wiener, SCIENCE, 98: 112, 1943; A. S. Wiener and E. B. Sonn, *Jour. Immunol.*, 47: 461, 1943). This agglutinin appears to be identical with the so-called anti-KJ agglutinin recently described in England (R. R. Race, G. L. Taylor, K. E. Boorman and B. S. Dodd, *Nature*, 152: 563, 1943).

In Table 1 is presented the former designations together with the frequencies of the types in a series of 871 white individuals. The new designations, given in Table 2, are suggested in order to overcome the following difficulties:

(1) The designation of type Rh in Table 1 is somewhat ambiguous because the term "Rh types" is usually used in a general sense. Therefore, I have adopted the suggestion of Race *et al.*[4] to designate this type as Rh_0,[5] and at the same time have changed the name of the standard anti-Rh agglutinin to anti-Rh_0, in order to make it correspond with its specific agglutinogen.

(2) The difficulty that the types Rh′ and Rh″ were not named after the antisera with which they react is now removed by naming the agglutinin giving 70 per cent. positive reactions anti-Rh′, while the agglutinin giving 30 per cent. positive reactions is named anti-Rh″. The designations of types Rh_1, Rh_2 and Rh_1Rh_2 still do not correspond with the antisera, but this is taken care of by the use of the alternative designations, Rh_0', Rh_0'' and $Rh_0'Rh_0''$, where these are necessary or desirable for the sake of clarity. Usually, however, the unambiguous and simpler designations, Rh_1, Rh_2 and Rh_1Rh_2, will still be found preferable.

TABLE 2

PROPOSED NEW DESIGNATIONS FOR THE RH BLOOD TYPES

Classes	Antisera			Designation of types	Antisera			Designation of types**
	Anti-Rh_0*	Anti-Rh′†	Anti-Rh″‡		Anti-Rh_0	Anti-Rh′	Anti-Rh″	
W	–	–	–	Rh negative	+	–	–	Rh_0
U	–	+	–	Rh′	+	+	–	Rh_1 (Rh_0')
V	–	–	+	Rh″	+	–	+	Rh_2 (Rh_0'')
UV	–	+	+	Rh′Rh″	+	+	+	Rh_1Rh_2 ($Rh_0'Rh_0''$)

* Anti-Rh_0 is the new designation for the standard anti-Rh agglutinin.
† Agglutinin formerly designated as anti-Rh_1.
‡ Agglutinin formerly designated as anti-Rh_2.
** Designations given in parentheses are optional and are to be used whenever necessary to avoid ambiguity.

Some confusion may result from the fact that sera containing the two agglutinins, anti-Rh_0 and anti-Rh′, and giving about 87 per cent. positive reactions, were formerly designated simply anti-Rh′. Such sera could now be designated as anti-Rh_1, so that the terms anti-Rh′ and anti-Rh_1 have been interchanged, and the same hold true for the terms anti-Rh″ and anti-Rh_2. All possibility of error can be avoided, however, if one designates the two sera containing two agglutinins as anti-Rh_0,Rh′ (or anti-Rh_0') and anti-Rh_0,Rh″ (or anti-Rh_0''), respectively, instead of using the shorter designations, anti-Rh_1 and anti-Rh_2.

[1] From the Serological Laboratory of the Office of the Chief Medical Examiner of New York City. Aided by grants from the United Hospital Fund and the Carnegie Foundation through the Committee on Human Heredity of the National Research Council.

[2] A. S. Wiener, *Proc. Soc. Exp. Biol. and Med.*, 54: 316, 1943.

[3] A. S. Wiener, E. B. Sonn and R. B. Belkin, *Jour. Exp. Med.*, 79: 235, 1944.

[4] R. R. Race, G. L. Taylor, D. F. Cappell and M. N. McFarlane, *Nature*, 153: 52, 1944.

[5] Interestingly enough, the identical idea occurred quite independently to the present author.

The six genes postulated under the author's theory of heredity are designated as *rh*, *Rh′*, *Rh″*, Rh_0, Rh_1 (or Rh_0') and Rh_2 (or Rh_0''), to correspond with the factors they determine. Incidentally, the frequency of type Rh_1Rh_2 given in Table 1 is slightly but significantly higher than that expected under the theory. While at first the writer was inclined to ascribe this to difficulties in the technic, this possibility has been ruled out by more recent studies. The excess of type Rh_1Rh_2 probably represents the effect of isoimmunization in pregnancy,[6] which would affect adversely principally infants of types Rh_1 and Rh_2. An observation favoring this idea is that the excess of individuals of type Rh_1Rh_2 is particularly pronounced in races characterized by large families and high infant mortality, *e.g.*, Chinese and Moslems.[7]

No attempt has been made to include the factor determined by the so-called anti-Hr serum of Levine and Javert[8] (or anti-St serum of Race and Taylor[9]) in the scheme. Levine believes that this factor is determined by a special allelic gene. However, unpublished observations by the writer indicate that this factor is related to the various Rh blood types in a manner analogous to that in which the factor detected by so-called anti-O sera is related to the A–B groups and subgroups (*cf.* Race *et al.*[4]). The observation that homozygous bloods of type Rh_1 fail to react with anti-St sera[9] can readily be explained in a manner similar to that proposed by the author to account for the behavior of anti-O sera.[10]

A. S. WIENER

BROOKLYN, N. Y.

[6] *Cf.* A. S. Wiener, SCIENCE, 96: 407, 1942.

[7] A. S. Wiener, E. B. Sonn and R. B. Belkin, unpublished observations.

[8] C. T. Javert, *Am. Jour. Obstet. and Gynec.*, 43: 921, 1942.

[9] R. R. Race and G. L. Taylor, *Nature*, 152: 300, 1943.

[10] A. S. Wiener and H. E. Karowe, *Jour. Immunol.*, in press.

NOTES ON STARRING IN AMERICAN MEN OF SCIENCE

IN accord with G. A. Miller's suggestion in SCIENCE for May 12 that Cattell's inauguration of a system of starring of scientists be discussed, and improvements on it suggested, excerpts are given from a study of starred psychologists[1] followed by some suggestions as to how the system of starring might be improved.

Cattell's inauguration of the system of starring the leading research workers in each of twelve fundamental sciences is considered by competent judges to have been a major contribution to the growth of research in America.

The star indicates that, in the private opinion of his peers, the starred psychologist is distinguished for psychological research. It implies either a large volume of good work or a considerable amount of especially original work. Of course it does not imply that the work done by others is not decidedly worth-while, but merely that it has not impressed the voters as quite so worthy of approbation.

The star is a recognition which not only gives the recipient satisfaction, but also increases his opportunities. It is a challenge to the recipient to continue his good work and to others who aspire to win this recognition. Vast amounts of good work have been completed as a result of this friendly rivalry. Many psychologists who are not starred feel confident that they are "as good a man as . . ." and consequently set out to prove it.

The good that starring does is increased by the widened knowledge as to who are starred and why. This widened knowledge not only encourages and puts the starred men more fully on their mettle, but it also attracts attention to their work and increases their opportunities for further research. It, moreover, augments the opportunities of promising persons not starred in the hope that, as a consequence of encouragement and improved facilities, they will win this coveted recognition. The various universities employing starred scientists are placing increased value upon this recognition as a proof of individual merit and institutional strength. They not only attempt to retain and attract men already starred, but also to have local men not yet starred win this high honor; to this end they often increase facilities and otherwise encourage their more promising men.[1]

SOME SUGGESTIONS

Objections to the system of starring which prevailed unaltered for 1908–1943 have largely been of five sorts. (1) Although in 1903 (when starring was first done) a large share of the scientists could be classified and rather fairly judged by the vote of leaders in one or another of twelve sciences, this is no longer true. Several additional sciences have become significant and specialization has interfered with many men feeling competent to vote on workers in allied disciplines. The fact that even some members of the National Academy of Sciences can not win a star because they are working in fields not recognized by Cattell in 1903 is a serious defect. Instead of 12 sciences, at least 20 should be recognized. (2) The number of men starred recently is too small. In 1903 the leading one fourth of all the scientists worthy of sketching in "American Men of Science" were starred. In the seventh edition of "American Men of Science" about 34,000 scientists are sketched, while only about 1,300 are starred. (250 newly starred, about 220 starred in 1937, about 200 starred in 1932, about 300 starred in 1921 or 1927 and the remainder starred in 1908 or 1903.) It appears that it is relatively fully 10 times as difficult to win a star now as it was in 1903. If instead of awarding stars to the top 25 per cent. of the scientists (as in

[1] S. S. Visher, *Am. Jour. Psychol.*, 52: 278–292, April, 1939.

1903), they were awarded to the top 10 per cent., the standard would remain sufficiently high. Yet on that basis, instead of 250 new winners each five years, there would be fully three times that number. (3) One of the unfortunate aspects of starring is that many men received almost enough votes to win a star. Such men may indeed be as worthy as some who received a few more votes and get starred. Perhaps if a symbol, perhaps an Indian arrowhead, were awarded to those who stood high enough in the opinion of the starred men (and others voting) to almost win a star, these men would be encouraged to increased effort. One result would be augmented research achievement. It is therefore suggested that, in addition to the one tenth starred, one tenth be given an arrow. (4) The original allotment of the 1,000 stars of 1903 among the sciences was based on the number of research workers in each. The proportion has changed greatly since then. For example, there are vastly more research chemists now than in 1903, and not many more anthropologists. Thus now a chemist has a far smaller chance of winning a star than an anthropologist. It is proposed that for each new edition of "American Men of Science" approximately the top 10 per cent. of each science be starred. *Moreover, the second one tenth* should receive public recognition, as by an arrow. Although stars won would not be deleted from the sketches, it is proposed that those won more than 15 years earlier be not counted in calculating the number of scientists eligible for a star. (5) The objections that stars are "undemocratic" and are too highly evaluated by administrators and others would be met somewhat by the proposed increase in their number and by the inauguration of the lesser recognition of an arrow.

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FISHERY DEPLETION

FOR over two years, a committee on depletion of the Fisheries Research Board of Canada has been functioning, with the undersigned as chairman. The increasing demand for fish for food as the war progresses has presented somewhat new problems in the use of this resource. The committee has attempted to clarify the situation as to greater production of fish, with the following result.

Depletion is often presumed when underproductivity of the fishery develops, that is, where the take in proportion to the effort fails to yield a satisfactory living to the fishermen. Usually such underproductivity develops sooner or later each year, which stops the fishery either automatically or by regulation based on experience. The fisherman then awaits natural replacement of the stock by the next year. If the stock of fish available is adequate, the remedy for underproductivity is improvement in fishing methods.

So long as the annual take corresponds with expectation based on past experience, the situation tends to be accepted without remark. Natural fluctuations in the abundance of the stock, which are largely of unknown origin, are quite usual and affect the take. When an increased take has continued for a number of years, it results in expectations of indefinite continuance. Then, a decrease in the take causes general complaint and an explanation is sought. Before attributing decreased annual productivity to overfishing, the possibility of natural fluctuation in stock being the cause should be excluded, which may be very difficult. Misinterpretation may lead to application of the wrong remedy.

Not infrequently intensive fishing is followed by a decrease in the average size of the fish. This may be merely the removal of an accumulated stock of very old fish and be irremediable except by reducing the fishing sufficiently to permit re-accumulation, which might be unwise. The amount not taken under the reduced fishing might be more than the gain through re-accumulation. If decrease in average size is accompanied by a decrease in production (weight of fish taken), it is often suggested that production could be increased if the fish were permitted to become larger by restricting fishing, particularly of the smaller fish. Carefully documented experiments with such restriction are desirable to establish it as wise procedure, since there are too many little known factors for any safe prediction of its effectiveness. Several such experiments are in progress.

Frequently the possibility is advanced that overfishing has resulted in under-replacement of the stock through decrease in the numbers of spawning fish. Since most species have a high reproductive capacity, this does not readily occur. Exclusion of anadromous fish from their spawning grounds by impassable dams definitely prevents replacement of the stock. Conceivably, overfishing might prevent full replacement of stock, but it is desirable to have carefully documented experiments to establish the need for restriction of the fishery to assure replacement. Leaving out of account such forms as the amphibious walrus of the Atlantic and fur seal of the Pacific, which are particularly vulnerable on their breeding grounds, we have as yet been unable to learn of a clear, documented case of under-replacement through overfishing for this continent. *Information on this would be* welcomed. It is proposed to undertake somewhat precise experiments to determine in particular cases how many spawners are required for replacement of the

stock, so that the full surplus may be taken for human use if desired.

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RESEARCH ON PHYSICAL CHEMISTRY IN THE U.S.S.R.

THE issue of *Zhurnal Fizicheskoĭ Khimii* (*Journal of Physical Chemistry*) 17: No. 5–6, 1943, released by the Academy of Sciences of the U.S.S.R. at the beginning of 1944, was received in this country a few days ago. This issue contains a review of the activities of the Karpov Institute of Physical Chemistry for the twenty-five years of its existence and carries an order of the Soviet government of October 20, 1943, decorating the institute, its director, Academician A. N. Bakh, and twenty-two co-workers for the proficiency and successes of their researches. Physical chemists will be interested in a bibliography given in that issue listing 825 publications of the Karpov Institute for the ten-year period 1933–1943, a substantial proportion of which are in English and German. The Karpov Institute comprises laboratories studying the following fields: (1) biological catalysis; (2) surface phenomena; (3) polymerization processes; (4) heterogeneous catalysis; (5) colloidal chemistry; (6) structure of matter; (7) chemical kinetics; (8) adsorption processes; (9) aerosols; (10) inorganic chemistry; (11) non-aqueous solutions; (12) solid and complex compounds; (13) x-ray; (14) physico chemical methods of production control; (15) photochemistry; (16) technical electrochemistry; (17) a division exists known as the Kireev group.

J. G. TOLPIN

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EDUCATION IN SCIENCE MUSEUMS; OR THE TEN PARTS OF THE FUNCTIONAL EXHIBIT

As the influence of the common man increases in world affairs, the extent of his knowledge and understanding will influence the future of all peoples. He can guard against emotional exploitation of his prejudices by developing critical habits of thought. He can build a barrier against rash judgments and actions by assembling within himself an understanding of man and the world around him. The education of the common man, on whose shoulders may hang the future of humanity, is a challenge to all museums of science.

Museums may meet this challenge with the functional exhibit. It portrays significant facts while impressing critical habits of thought on museum visitors; it compares a familiar with a strange way of satisfying a basic human need; it reveals truths discovered in the scientific search for ways to satisfy basic needs; it rouses curiosity; it stimulates the visitor to do something constructive with his learning.

There are fewer than fifty fundamental discoveries, from which man derives the millions of articles he uses to satisfy three basic needs. So the story of human progress can be told within the space of any museum, and even within the space of a single room, when this story is told through functional exhibits.

At the entrance to a science museum, which tells the story of human progress in functional exhibits, the visitor meets something familiar, perhaps a coin, a button, a light, actively doing something he readily understands, and in which he can easily take part. Compared with the familiar object is an unfamiliar one, used by strange people to meet the same need. This comparison stimulates curiosity and proclaims the main theme of the museum to be systematic comparison, which is also the crux of scientific thinking. After this friendly introduction, which rouses curiosity, stimulates critical thinking and does not block thought with enervating awe, the visitor is told what lays before him in the museum, what the museum aims to do, and why it will do just that.

At the start a frame is presented into which the visitor can fit what he knows and what he will learn. The visitor is told why men learn, to better satisfy their basic needs, and how the museum aims to aid that learning, by comparing primitive and civilized ways of satisfying basic needs and by tracing crucial steps in the evolution of the more effective ways. The visitor is told how to proceed through the museum to benefit most fully from it, to look at one exhibit at a time and understand it fully before advancing. The visitor is told to pick out of each exhibit a crucial fact and compare it with what he knows; he is told to challenge anything that differs from his own experience, accepting nothing on unproved authority. He is told to approach each exhibit with thoughts about it and it alone, which is the objective or problem attitude that psychologists have shown, in systematic experiments, produces the swiftest solutions to puzzles and problems. He is told to look in each exhibit for two ways of satisfying a basic need, and after comparing them decide which is best, and why. He is told where, in exhibits and in libraries, he may find facts that will answer his questions.

At the start and at strategic places throughout the museum, the visitor may be confronted with a chart of basic human needs, raw materials, main transforming processes—the fundamental ideas, discoveries and inventions by which man has created useful goods—and the main habits, customs and institutions through which these goods are controlled and used to satisfy common human needs. This chart, summarizing the

main facts of human progress, may focus the thoughts of the visitor on fundamental facts, as he tries on his way through the museum to integrate the numerous facts of separate exhibits into a pattern of significant knowledge.

Major themes may run throughout the exhibits of a great museum as they run throughout the movements of a great symphony. Two major themes for the functional exhibits of a science museum are: comparison, and value of facts in satisfying basic human needs. Each major theme may appear in each exhibit so the visitor may pick it up anywhere, no matter how widely he ranges or what order he takes in the exhibits. Minor themes, which are limited to single exhibits, tie the facts of the exhibit into something significant in the life of each visitor.

Each functional exhibit, which carries out two major and one or more minor themes, may consist of ten parts: (1) An experience common to all visitors, portrayed in a familiar object (*e.g.*, an electric torch) performing a familiar function (*e.g.*, lighting a path at night) by which visitors help satisfy a basic need (it makes the path a more predictable and a safer place on which to walk). The familiar object and way of satisfying a common need (*e.g.*, pressing a button to light a dark path) are (2) compared with a primitive tool and way of trying to satisfy the same basic need (*e.g.*, a reed torch used by the Loma in Liberian Africa).

The exhibit then traces the main steps of human progress in which man developed the familiar tool, by presenting (3) a fundamental idea (*e.g.*, freedom of search and expression which creates an atmosphere conducive to discovery), (4) a basic discovery (*e.g.*, electricity) and (5) crucial inventions (*e.g.*, the electric battery and generators, transmission of electricity by wires and resistance of some materials resulting in the electric light). The exhibit then presents the (6) main habits (*e.g.*, turning on a switch) customs (*e.g.*, politely shading the eyes of others from glare, reflected in the auto regulation controlling intensity and direction of headlights) and institutions (*e.g.*, laws, courts, patents) of control and use of the "tool" in satisfying a (7) basic human need (for predictable and favorable surroundings) and some advantages of the superior way of meeting the need (*e.g.*, the superior way of lighting a path at night produces less stumbling, fewer accidents and injuries).

The visitor indicates comprehension and alertness by (8) doing something about what has gone before (*e.g.*, presented with a question and a series of answers, the visitor may select a correct answer from the series before him by pressing a button or by some other action; the exhibit may then compliment him or, if he is in error, comment on his error and ask him another question). An arrangement, in which the visitor may participate, raises a question about the exhibit, and (9) indicates where an answer can be found in the museum, in a library or elsewhere. The exhibit ends by (10) stimulating the visitor to do something about what he has learned (*e.g.*, construct a toy, picture, poster or otherwise express a constructive reaction to what he has seen by describing in some way what he has learned for the benefit of others).

Learning from museum exhibits may be facilitated in a number of ways. The stimuli of the exhibit may be strengthened by tricks of lightning, use of colors and other art devices coupled with coordinated sounds and figures that move and speak. Movement not only of figures, but also of the background or the onlooker may enhance the effectiveness of the exhibit. Crucial meanings may be dramatized. Character portraits and personality profiles may help to impress ordinary visitors with the habits behind the triumphs and discoveries of critical thinkers. Plays, pictures and other artistic expression of the stories in exhibits may facilitate learning of the facts presented there.

Descriptive labels may tersely telescope thoughts pointing to crucial facts. Labels may also furnish the visitor with cross-indexes to sources and other aids to further search. The visitor should come away from each exhibit, and from the museum, thinking about a problem, its solution and its relation to larger problems, now before the citizens of the world.

Functional exhibits help the museum visitor understand strange ways of acting, strange habits, strange customs and strange institutions and strengthen within him constructive attitudes toward his neighbors. In functional exhibits numerous fundamental facts are related to three basic human needs and through them are related to each other, so they help create a reasonable uniformity of educated opinion, in spite of individual human differences. In comparing the ways in which men act functional exhibits may influence views of how men should act, and lay the groundwork of a scientific approach to the moral and political issues confronting mankind. None of the institutions of civilizations are better equipped than the science museum for educating the common man in the crucial facts of civilized life.

When science museums construct functional exhibits that rouse curiosity, encourage the making of comparisons and tell the story of human progress in significant patterns of crucial facts, then the museum will become the university for the common man, helping to shape the thinking and the future of all the peoples of the earth. This is worth doing.

ROBERT H. MORRY

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SCIENTIFIC BOOKS

OPTICAL ACTIVITY

Optical Activity and Living Matter. By G. F. Gause. No. 2 of a series of monographs on general physiology edited by B. J. Lujet. 162 pp. Normandy, Missouri: *Biodynamica.* $2.75.

The author presents this monograph as a review of the widely scattered literature pertaining to the structure and the activity of living systems as related to the asymmetric configuration of their constituents. Thus, Dr. Gause's monograph covers a general ground in part identical with the subject of F. M. Jaeger's well-known treatise, "The Principle of Symmetry," and the same author's George Fisher Baker Lecture, "The Spatial Arrangements of Atomic Systems and Optical Activity." However, the two authors approach their subject from different angles. While Jaeger considers the symmetry relationships of static systems, Gause gives greater emphasis to the dynamic effects and in particular, to the dynamic biological effects of asymmetric systems.

The five chapters of Dr. Gause's monograph are preceded by a short introduction, in which the general principles and definitions are given. Here, Dr. Gause distinguishes between dissymmetry and asymmetry. In an attempt to overcome "some confusion in the terminology," he defines dissymmetry as the property of molecules possessing non superimposable mirror-images, while he regards asymmetry as the property of molecular aggregates presenting a predominance of the right or the left form of dissymmetric molecules. Obviously, Dr. Gause's terminology will not remain unchallenged.

The first chapter deals with the optical activity of biological material. Asymmetry of molecular aggregates is regarded as a specific property of protoplasm and of living systems. The author forwards the thesis that the primary constituents of protoplasm such as the amino acids, the lecithins and the majority of the important sugars, occur in protoplasm in the form of only one of the optical isomers. They are obligatorily asymmetric and the author speaks of the exclusiveness of the asymmetry-sign in primary substances. Secondary substances, *i.e.,* substances possessing non-obligatory asymmetry, are said by Dr. Gause to be found in nature in the dextrorotatory as well as in the levorotatory form or as inactive racemates. It appears to the reviewer that it is not an easy task to agree upon an unambiguous definition by which primary and secondary biological substances can be distinguished. Amino acids, for example, are listed as primary substances. After the recent discovery of d-glutamic acid, d-proline, d-leucine, d-valine and d-phenylalanine as building stones of biological substances, do we now have to degrade amino acids to the rank of secondary substances? On the other hand, one may ask whether the distinction between primary and secondary protoplasmic constituents is concerned with optically active substances only and does not cover substances such as acetylcholine, pyruvic acid and certain optically inactive vitamins.

The second chapter is devoted to a discussion of origin and maintenance of optical activity. Here, the author illustrates the thermodynamic, kinetic and enzymologic aspects of one of the most attractive problems of biology. He does not fail to point out the gaps and inconsistencies, which, at the present state of our knowledge, still obstruct the clarity of our understanding. As to the origin of the initial optical activity of the components of protoplasm, Dr. Gause briefly presents the two principal theories: the asymmetric photochemical influence of terrestrial circularly polarized light upon racemates, on the one hand, and asymmetry as originating through fluctuations around the statistical mean value of equality of left and right isomers, on the other. Considerably more space is given to the mechanisms by which asymmetric syntheses are performed and optical activity is maintained in living matter at the present stage of evolution. Of the subjects and theories discussed by Dr. Gause in this connection, a few may be mentioned in this review. The interaction of two optically impure substances may, according to Langenbeck and Triem, lead to the synthesis of an optically active material of higher optical purity, when the reaction is interrupted before completion. Werner Kuhn's theory, ascribing the ageing of organisms to the progressive racemization of their optically active constituents, is also related. Another point is the production of an optically active substance from symmetric material, such as the formation of glucose and starch during the assimilation of carbon dioxide by green plants or the enzymatic synthesis of mandelic acid from benzaldehyde and hydrocyanic acid. However, all such asymmetric syntheses known to be performed by living matter depend upon the presence of optically active enzymes and the reviewer can not help but feel that these asymmetric enzymatic syntheses do not elucidate the mechanism by which the first optically active substance, after it had first been formed at the dawn of evolution and before any optically active enzyme existed, could have survived and transmitted its optical activity to other substances. Was the first optically active substance an enzyme and was it, at still an earlier period of evolution, preceded by optically inactive enzymes? Very recently, many proteolytic enzymes have been discovered which are adapted to substrates containing not *l*-amino acids but the "unnatural" *d*-amino acids. Are these *d*-enzymes remnants of such a hypothetical early period at which

each enzyme may have existed in equal quantities of its *d*- and *l*-forms?

Chapter III deals with heredity and the influence of environmental factors on the optical activity of biological material. First, several experiments are reported which the author presents as "proving the impossibility of inverting the optical properties of the primary constituents of protoplasm or of modifying protoplasm so as to cause it to invert the optical properties of the products of its metabolism." This is followed by a discussion of various mechanisms controlling the biological production of a given optical isomer.

Chapter IV deals with the relation between the inversion of spirally twisted organisms and the molecular inversion of their protoplasmatic constituents. The optical activities of protoplasmatic constituents in dextral and sinistral specimens of an organism have been found to be identical, *e.g.*, the same optically active forms of the various amino acids have been isolated from both the sinistral and the dextral forms of a snail.

In Chapter V, Dr. Gause discusses the asymmetric analysis of the mechanism of biological processes by the study of the differential influence of optical isomers. The author has applied this asymmetric analysis to the study of the mechanism of toxic action, to the evolution of the nervous system and to various physiological functions in protozoa.

In the last three chapters, the author moves in his own experimental field and, therefore, can draw from his own many experimental findings.

In a short appendix, the author discusses the structure of the cancer cell. He mentions the claim of Kögl and Erxleben to have isolated *d*-glutamic acid from malignant cells. The contradictory findings of Chibnall, of Graff and of Lipmann are also reported together with some other recent literature pertaining to this aspect of the cancer problem.

Dr. Gause's monograph presents in a rather limited space a great number of experimental results and theoretical data. It can be recommended as very stimulating reading.

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PLASTICS AND SYNTHETIC RESINS

A Laboratory Manual of Plastics and Synthetic Resins. By G. F. D'ALILIO. 134 pp. New York: John Wiley and Sons, Inc. 1943. $2.00.

DURING the past decade the literature covering all phases of the plastics industry has grown to such proportions that any one wishing to acquaint himself with the industry as a whole is likely to become lost in the details and references pertaining to the subject. Even those engaged in the industry are for the most part specialists in one or two branches of this highly diversified industry. Those engaged in the development of synthetic molding powder often know little of the field of surface coatings and the research worker who is thoroughly acquainted with the literature of phenolic resins may, for example, have but a nodding acquaintance with the theory of styrene polymerization.

As a quick ready reference for introductory methods for preparing the various synthetic resins of industrial importance, Dr. D'Alilio's "Laboratory Manual" will be an invaluable aid. Fortunately, the author has seen fit to limit the scope of this manual to experiments covering only those resins of recognized industrial importance and thereby avoiding the possibility of thoroughly confusing the student. Even so, the manual includes 40 synthetic resin preparations with accompanying experiments covering reaction variables and methods of product evaluation as surface coatings, adhesives, molding powders, plywood, synthetic rubber and others. On this basis the resins prepared from the original raw materials are used in successive evaluation experiments and for comparative tests with other resins to give the student a first-hand knowledge of the relative merits of the basic resin types covered.

A series of questions and added exercises follows each of the experiments. The questions are based on the assumption by the author that the student has had a course in organic chemistry, and while many of the answers to the questions lie within the experiment performed, the student will find it necessary to refer to the literature on the subject to check his conclusions. The suggested extensions of the various experiments are very comprehensive and explain why the field of plastics is one of specialization.

In addition to the series of 88 experiments, the author lists a series of 26 test methods. Some of these methods are straightforward organic test methods, such as the determination of formaldehyde by the hydroxylamine hydrochloride or sodium bisulfite methods, but many of the methods listed are empirical ones developed by the industry to fulfil a definite need. The determination of the softening point and the rate of cure of resin are examples of such methods.

The author has also thoughtfully included in the appendix a list of the raw materials required for performing the various experiments and several sources for obtaining them. This is indicative of the thoroughness with which the "Laboratory Manual" has been compiled and thus it will not only admirably fulfil its intended function as a student laboratory manual but also aid those workers of the plastics in-

dustry who wish to become better acquainted with plastics other than those with which they are thoroughly familiar.

L. M. Debing

MANOMETRIC MEASURES

Manometric Methods. By Malcolm Dixon. xiv + 155 pp., 20 figures. New York: The Macmillan Company. Cambridge: The University Press. Second edition. 1943. Price, $1.75.

The manometric method, as embodied in the familiar Warburg apparatus, has become increasingly valuable to the physiologist, biochemist and more recently to other classes of investigators, particularly food technologists who have been impressed with the versatility of the technique.

Manometric manipulations, though exacting, are regarded by many with undue awe. On the other hand, there are some who have used them without sufficient regard for the pitfalls which necessarily exist in a method so delicate. This excellent little book, now in its second edition, should be most helpful to both types of investigators. The author's object—to provide a handbook for the laboratory, supplying in convenient form just that information which is likely to be required by research workers using the methods—has been fully realized.

Part I of the book comprises a discussion of principles and includes a satisfactory account of the theory involved in each of the methods described.

Part II contains a detailed description of the main methods now available: the direct and indirect method of Warburg, the first and second methods of Dickens and Simer and the method of Dixon and Keilin. A brief outline of the micro-technique is also given.

The book might have been improved by a presentation of the recent work on new applications and a description of the excellent new equipment now commercially available.

Charles N. Frey

SPECIAL ARTICLES

ESSENTIAL FATTY ACIDS AND LIPOTROPIC ACTION OF INOSITOL

Over a year ago the author became interested in the possible effect of essential fatty acids on the lipotropic action of choline. If choline lowers fat in the liver by virtue of its incorporation into the lecithin molecule, then essential fatty acids, which also constitute integral parts of this phospholipid, might similarly be required before choline can exert this effect. A preliminary experiment of three weeks' duration, using rats 100 to 125 grams in weight, suggested that the essential fatty acids were not required for the action of choline, although the results obtained did suggest that choline decreases liver fat to a greater extent when these metabolites are present. However, the difference found was of questionable statistical significance. It was realized that the three-week period would not have permitted a marked depletion of the animals' stores of essential fatty acids, and an experiment of longer duration was contemplated.

In the meantime Engel's paper[1] on the relation of the essential fatty acids to the lipotropic action of choline was published. In an experiment of eight weeks' duration performed on weanling rats, Engel found that pyridoxine was required for the full lipotropic action of choline. Because of the relationship of pyridoxine and essential fatty acids in the cure of rat acrodynia, Engel determined under similar conditions the effect of essential fatty acids on the lipotropic action of choline. He found that they also augmented the lipotropic action of this substance.

[1] R. W. Engel, *Jour. Nutrition*, 24: 175, 1942.

An experiment of eight weeks' duration was devised to test the effect of essential fatty acids upon the lipotropic action of choline and also of inositol since it, too, is a constituent of certain phospholipids and its influence might be similarly affected by essential fatty acids in the diet. The basal diet chosen for this experiment consisted of 8 per cent. casein, 12 per cent. casein, 12 per cent. gelatin (both extracted with 1:1 alcohol-ether), 73 per cent. sucrose, 5 per cent. salt mixture, 2 per cent. agar, 0.015 per cent. vitamins A and D concentrate (Ayerst, McKenna and Harrison, containing 500,000 I.U. of A per gram and 50,000 I.U. of D per gram). A mixture of the B vitamins in the following amounts was injected daily in 0.5 ml physiological saline: thiamine chloride, 50 α, riboflavin, 25 α, pyridoxine, 20 α, calcium pantothenate, 100 α, nicotinic acid, 100 α. Twenty weanling rats of the Wistar strain (23 to 35 days old) were used for each group and litters were divided as evenly as possible amongst the different groups.[2] The groups were also balanced with respect to weight and sex. After eight weeks on the diet, the rats were killed by a blow on the head. Individual liver fats were determined in the usual way by saponification, acidification and extraction of the fatty acids with petroleum ether. Table 1 shows the results obtained.

This result supports Engel's statement that the lipotropic action of choline is increased in the presence of Mazola oil presumably through the action of essential fatty acids[1]. The lipotropic action of inositol on

[2] The mortality of the rats on the choline-free diets was quite high because of the development of hemorrhagic kidneys.

TABLE 1

EFFECT OF ESSENTIAL FATTY ACIDS ON LIPOTROPIC ACTION OF CHOLINE AND INOSITOL

Diet No.	Supplement per cent. of diet	Fatty acids per cent. liver weight
1. (Basal)	. . . .	23.4
2.	Choline chloride (0.5)	6.43
3.	Inositol (0.3)	13.3
4.	Mazola Oil (1.0)	25.3
5.	Mazola Oil (1.0) + Inositol (0.3)	27.2
6.	Mazola Oil (1.0) + Choline (0.5)	4.71

the other hand was obliterated by the inclusion of Mazola oil.[3] A possible explanation of this phenomenon might be that certain fatty acids in this oil make the diet more nearly adequate, increasing the demand for lipotropic factors and thus promoting a greater deposition of fat in the liver. But in view of the results with choline the writer believes that one must look elsewhere for the true explanation.

It is more probable that the nature of the fatty liver is changed in the presence or absence of the various supplements used. It will be recalled that choline has a relatively greater lipotropic effect on the "fat" fatty liver than on the "cholesterol" type of fatty liver, whereas with inositol, the reverse is true.[4] Only a complete analysis of the liver fats would reveal whether or not such a hypothesis is tenable. Fractionation of the fats from the livers of rats fed diets identical with those described above is now in progress and the results will be published shortly.

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STUDIES ON THE TOXICITY AND ACTIVITY OF STREPTOTHRICIN

IN 1941 Waksman and Woodruff[1] reported on the isolation and properties of streptothricin, a bactericidal substance obtained from a soil organism named *A. lavendulae*. Recently, Foster and Woodruff[2] published on the *in vitro* action of streptothricin against bacteria, fungi and yeast. However, with the exception of a short note published by Metzger[3] on the action of this agent in experimental brucellosis, nothing has appeared in the literature regarding the *in vivo* activity or toxicity of this substance. The present communication is mainly concerned with these factors.

[3] Preliminary results of current investigations indicate that the substitution of a fat devoid of essential fatty acids does not interfere with the lipotropic action of inositol.

[4] G. Gavin, J. M. Patterson and E. W. McHenry, *Jour. Biol. Chem.*, 148: 275, 1943.

[1] S. A. Waksman and H. B. Woodruff, *Proc. Soc. Exp. Biol. and Med.*, 49: 207, 1942.

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EXPERIMENTAL

Materials: The streptothricin[4] used varied in potency from 5,000 to 300,000 units[5] per gram of solid. The drug is readily soluble in water, and was administered as an aqueous solution. The mice used were of the CFI strain and weighed between 18 to 21 grams each.

Toxicity Studies: These experiments were performed in mice by administering single doses of streptothricin intravenously, subcutaneously and by mouth. The dose levels employed and the data obtained are presented in summary form in Table 1. Mice injected intravenously or subcutaneously with dose levels of 30,000 units per kgm produced no evidence of toxicity throughout the five-day observation period. Dose levels of 60,000 units/kgm (approximately 10 to 12 times the effective dose) produce some deaths when given by vein, but no untoward effect by the subcutaneous or oral route. Large doses by the subcutaneous route produced toxic signs in mice. Streptothricin was well tolerated when given by mouth in that single doses of 250,000 units per kgm appeared

TABLE 1

ACUTE TOXICITY OF STREPTOTHRICIN FOR MICE

Dose in units/kgm	No. of mice/dose	Per cent. mortality (5 days observation) i.v.	s.c.	oral
30,000	10	0	0	0
60,000	10	20	0	0
125,000	10	20	30	0
250,000	10	80	100	0
500,000	10	100	100	10
750,000	10	..	...	30

TABLE 2

BACTERIOSTATIC ACTION OF STREPTOTHRICIN IN AGAR

Organism	Units per cc of agar required to produce complete inhibition
Strep. hemolyticus 1685	32
Strep. hemolyticus MIT	256
Strep. hemolyticus M	256
Strep. viridans	> 1024
Strep. lactis	> 1024
Staph. aureus SM	16
Staph. aureus FDA	128
Staph. aureus SD	128
Staph. aureus 155	128
Diplo. pneumoniae Type I	32
B. mycoides	1024
B. subtilis	32
E. typhi	4
S. aertrycke	16
S. enteritidis	64
S. schottmülleri	16
B. flexneri	32
B. sonne	128
P. lepiseptica	32
B. proteus	512
B. pyocyaneus	256
N. meningitidis	256
E. coli	16
S. leutea	256
A. aerogenes	256

[4] The streptothricin employed in these studies was obtained from the chemists of the Research Laboratories of Merck and Co., Inc., from cultures grown by Dr. J. W. Foster.

[5] A unit of streptothricin is the minimum quantity of drug which when added to 1.0 cc of nutrient broth will inhibit a given strain of *E. coli*.

to be without effect on mice. However, when sufficiently large doses (500,000 units/kgm) were given, signs of anorexia, accompanied by a gradual loss of weight, developed in most animals, and 10 per cent. of the mice died.

Efficacy: In vitro studies performed by incorporating streptothricin in melted blood agar and streaking the surface of the solidified agar with a variety of pathogenic bacteria, show this substance to be highly effective against organisms of both the gram-negative and gram-positive group (Table 2). Organisms of the colon-typhoid group and the Salmonella group are particularly sensitive. Thus quantities as small as 4 units per cc of agar were sufficient to inhibit completely the growth of *E. typhi*. Certain strains, such as *B. pyocyaneus* and *B. proteus, S. viridans* and *S. lactis,* were highly resistant to streptothricin.

The *in vivo* experiments were performed with a number of gram-negative and gram-positive pathogens. Infection was produced by intraperitoneal injection of 10,000 lethal doses of the test organisms, and treatment, initiated immediately after the infection, was given intravenously, intraperitoneally, subcutaneously and by mouth. Therapy consisted of either a single or repeated doses, the latter varying from once every six hours to once daily over a five-day period.

The results obtained with a number of the gram-negative organisms were of the same order, and therefore only the findings with a single test organism are presented in Table 3.

Streptothricin in single doses of 50 to 100 units per mouse (2500 to 5000 units/kgm) given intravenously or subcutaneously shortly after the bacterial inoculation afforded excellent protection against *S. schottmülleri* infections. Smaller amounts given intraperitoneally protected a large percentage of the mice. Similar results were obtained with strains of *S. aertrycke, E. coli and B. shigalis.* When administered by mouth, streptothricin was much less effective than following parenteral therapy. Doses of 3,000 units per mouse were required by mouth to afford the same protection as 100 units by vein or by the subcutaneous route. Repeated doses of streptothricin appeared to offer no great advantage over the single dose therapy, although in the lower dose levels the best results were obtained by administering the drug every six hours.

TABLE 3

EFFICACY OF STREPTOTHRICIN IN MICE INFECTED WITH S. SCHOTTMÜLLERI (SUBCUTANEOUS THERAPY)

Organism: *Salmonella schottmülleri*
Age of Culture: 6 hours
Infection: 0.5 cc of a 10^{-5} culture dilution in 4 per cent mucin
Therapy: Streptothricin given subcutaneously immediately after bacterial inoculation.

No. of mice	Drug	Units/dose	No. of doses/day	Culture dilution	No. surviving in days 1	2	3	4	5	6	7	8	Per cent survival
				(Therapy: A single dose)									
30	Strepto-	12.5	1	10^{-5}	3	0	0	0	0	0	0	0	0
65	thricin	25.0	1	"	25	23	18	16	15	15	15	14	21.5
65		50.0	1	"	49	44	43	41	37	37	34	34	52.4
65		100.0	1	"	65	62	62	60	59	59	59	59	90.8
35		200.0	1	"	35	35	35	35	35	35	35	35	100.0
				(Therapy: Single Daily Doses over a 5-day period)									
20	Strepto-	12.5	1	10^{-5}	2	1	0	0	0	0	0	0	0
20	thricin	25.0	1	"	9	5	4	3	1	1	1	1	5
20		50.0	1	"	18	13	12	12	12	11	11	11	55
				(Therapy: Every 6 hours over a 5-day period)									
20	Strepto-	12.5	4	10^{-5}	20	4	3	3	3	3	3	3	15
20	thricin	25.0	4	"	20	6	3	3	1	1	1	1	5
20		50.0	4	"	20	20	20	20	20	20	20	19	95
20		100.0	4	"	20	20	20	20	20	20	20	20	100
				(Therapy: None)									
65	Controls	....	..	10^{-5}	6	1	0	0	0	0	0	0	0
30	"	....	..	10^{-6}	3	0	0	0	0	0	0	0	0
30	"	....	..	10^{-7}	16	10	7	5	3	3	3	3	10
30	"	....	..	10^{-8}	16	9	8	7	6	6	6	6	20

Certain gram-negative organisms and most gram-positive species were quite resistant to the action of streptothricin *in vitro*. The course of the infection in mice produced by strains of *B. pyocyaneus, B. proteus, Staph. aureus* and *D. pneumoniae* was not markedly influenced by streptothricin, even when doses approaching the toxic range were administered. Likewise, streptothricin had no significant influence on the virus of epidemic influenza or on *Trypanosoma equiperdum* infections in mice.

SUMMARY AND DISCUSSION

The foregoing experiments indicate that crude streptothricin is markedly effective *in vitro* against many gram-positive and gram-negative organisms. Furthermore, mice heavily infected with a variety of gram-negative organisms are completely protected by

the administration of small amounts of streptothricin. The drug is more effective parenterally than when given orally. However, preliminary experiments show that streptothricin by mouth greatly reduces the lactose fermenting bacteria of the intestinal tract. In this respect the drug is similar to certain sulfonamides and suggests, therefore, that streptothricin may be of value in bacillary dysentery and typhoid fever. The marked effect of streptothricin *in vitro* against gram-negative and gram-positive organisms, coupled with the fact that body fluids have no apparent inhibitory effect on the action of streptothricin, suggest that the crude drug might be of great value in infected wounds and burns.

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THE TIDAL AIR OF LABORATORY ANIMALS[1]

BECAUSE of the increasing need for information concerning the tidal air of laboratory animals we desire to present a general formula for such a determination on resting and fasting animals and to present the results of experimental tidal air determinations under conditions more nearly resembling those found during inhalation experiments with infectious nuclei.

In determining the tidal air by formula it must be assumed that animals use up the same proportion of oxygen from the air as man, *i.e.*, approximately 5 per cent. Thus, animals under basal conditions inspire 20 liters of air for each liter of oxygen consumed. The oxygen consumption in 24 hours in animals and man can be estimated from the basal heat production which for warm-blooded animals from rats to steers averages (72 $W^{3/4}$) calories, where W is the body weight in kilograms.[2] Since one liter of oxygen consumed by fasting animals represents 4.7 kilocalories of heat, the basal rate of oxygen consumption amounts to $\frac{72}{4.7} W^{3/4} = 15.3\ W^{3/4}$ liters of oxygen per day, or 306 $W^{3/4}$ liters of air per day, or $\frac{306 \times 1000}{1440} W^{3/4} = 212\ W^{3/4}$ cc of air per minute.

To determine the tidal air of 27-day-old albino Swiss mice under conditions more nearly approaching those found during inhalation experiments in which the mice are not at a basal condition, respiration trials were made in an apparatus previously described by Kleiber.[3] Animals were taken from a large cage containing food and water, divided into 7 groups of 10 mice each, and then placed in the respiration cages. The temperature during the run was 30° C. The mean metabolic rate of the animals during the whole trial (3 hours) was 119 kilo-cal./day/$Kg^{3/4}$; for the third hour only it was 97 kilo-cal./day/$Kg^{3/4}$. The mean weight per mouse at the end of the trial was 10.5 ± 0.25 gms. By the use of the formula, resting and fasting mice of 10.5 gms weight are calculated to have a tidal air of 7.0 cc per minute.

The tidal air of these animals as calculated from the metabolic rate was obviously decreasing from the start of the fast, as shown by the following figures.

Time in hours from start of fast	Mean tidal air per mouse per minute, in cc's
0.5	15.0 ± 0.8
1.0	11.7 ± 0.8
1.5	10.8 ± 0.7
2.0	10.5 ± 0.5
2.5	8.7 ± 0.3
3.0	9.3 ± 0.4

Some of the high rate in the initial half hour may be due to the effect of handling of the animals, but it is believed that the fasting was an important factor in the observed decrease. These data are comparable to the results of Loosli, Robertson and Puck[4] who used heavier, partially anesthetized animals and a different technique.

In some recently published experiments[5] we had occasion to determine the tidal air of a 3.5 kg *Macacus rhesus* monkey under intravenous pentabarbital anesthesia by means of a tracheal canula attached to a respirometer. Under deep anesthesia, when the respirations were shallow, three respirometer trials averaged 546 cc of air per minute. A resting and fasting monkey of the same weight would have a tidal air of 543 cc per minute as determined by the formula.

The basic heat formula is a useful tool for those interested in the biology of respiratory infections, since the tidal air of any laboratory animal can be quickly estimated if the weight is known. The data presented point out the need of having animals in a basal state in order to reduce the number of variables in inhalation experiments.

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A NEW MALE-STERILE MUTANT IN THE TOMATO

HETEROSIS, expressed in increased yield and earlier fruiting, has been frequently demonstrated in first-generation hybrids between certain horticultural varieties of *Lycopersicon esculentum* Mill.[1] The labor required to emasculate and pollinate flowers for the production of hybrid seed has heretofore prevented the widespread horticultural exploitation of this phenomenon. Barrons and Lucas[1] describe certain simplifications of technique that would reduce the amount of necessary labor. They also make a suggestion: if a male sterile type were used as the female parent in a program of cross-pollination, the need for emasculation would be eliminated. Currence[2] proposes for the same purpose the use of a type which has a stigma exserted beyond the anther tips and which therefore, when artificially pollinated without emasculation, yields a large percentage of hybrid offspring.

An unfruitful plant discovered here by Dr. Paul G. Smith was found to owe its barren condition to male-sterility. This plant and its male-sterile offspring are characterized and readily identified by anthers lighter in color and variously more shrunken than the anthers of male-fertile plants. The sporogenous tissue of male-sterile anthers develops normally until the formation of PMC's. Because further development is halted, as testified by the absence of all meiotic figures save the earliest stages, no pollen is produced. Fertility of the ovules is impaired only slightly if at all by the male-sterile genotype: the mean number of seeds per fruit produced by hand pollinations of five male-sterile plants—86—compares favorably with the mean number—91—observed in similar treatment of eight male-fertile sibs.

TABLE 1

SEGREGATION OF MALE-STERILITY IN F_1, F_2 AND BACKCROSS PROGENIES

Progeny No.	Nature of pedigree	Male fertile plants		Male-sterile plants	
		Obtained	Expected	Obtained	Expected
42L1	F_1	25	25	0	0
43L1	F_2	20	26 25	6	8.75
44L12	F_2	14	15	6	5
44L16	F_2	28	27	8	9
44L24	F_2	22	24	10	8
44L11	m.s. $F_2 \times F_1$	7	8.5	10	8.5
44L2	male-sterile F_2 × male-fertile F_2*	19	18	17	18
44L5		14	13	12	13
44L6		12	12.5	13	12.5
44L8		49	49	0	0
44L18		15	16	17	16
44L20		16	18	20	18
44L21		27	27	0	0

* These are essentially backcrosses planned to determine the genotype of seven random F_2 male-fertile plants.

The transmission of this character to F_1, F_2 and backcross generations, summarized in Table 1, argues recessive monogenic determination and an equal viability of male-sterile and male-fertile phenotypes. This male-sterile type could therefore be readily propagated from seed by backcrossing heterozygotes to male-sterile individuals.

Where hand-emasculated male-fertile plants are used in the large-scale production of hybrid seed, a considerable risk of contamination by self-pollination might be encountered, because any flower accidentally overlooked would produce seed by self-pollination. In contrast, the only source of contamination involved in the use of male-sterile plants is natural crossing. This factor is inconsequential according to Jones,[3] Lesley[4] and Currence and Jenkins[5]; in the present studies not a single fruit was set by open-pollination on six male-sterile plants growing during the summer of 1943 among male-fertile sibs.

The male-sterile tomato reported by Lesley and Lesley[6] differs in two respects from the one reported here: it is determined by two or possibly three factors, and it produces morphologically normal but non-germinable pollen and so is less readily identified. This difference in expression and inheritance points to a different genetic basis of these two mutants.

The writer has observed that mutations to male-sterility occur often enough to warrant search for them in any desired variety. The nearly exclusive propagation by self-pollination in the tomato favors the appearance of viable recessive mutants. Furthermore, when plants are unfruitful by virtue of genetic male-sterility or any of several other cytogenetically conditioned sterilities, their very aggressive vegetative habit renders them conspicuous in fields late in the harvest season. Accordingly, a large number of sterile plants can be readily obtained, and the male-sterile mutants among these can be identified by cytogenetic tests. This method of securing male-sterility in a given variety is believed to be more efficient than the customary procedure of backcrossing a male-sterile mutant to the desired variety. Three varieties of tomato were scanned in this manner for male-sterile types in 1943; and, with comparative ease, morphologically male-sterile types were found in each variety.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE DROP RECORDING SYSTEM

MANY types of drop recorders have been devised. Most are difficult to maintain. Some utilize the force of the falling drop, while others utilize the conductivity of the drop to complete an electrical circuit. With the usual arrangement in the case of the latter a sensitive relay is required to actuate the recording device.

By the use of a bell-ringing transformer actuated by house current in place of the relay, the apparatus becomes entirely free of troublesome contacts and moving parts. This has the advantages of being simple, non-mechanical, sensitive to electrolyte solutions of low concentration, easy to construct and maintain, and useful under a wide variety of conditions. It is made of a few common pieces of inexpensive and readily available equipment.

The electrode gap of a conventional falling drop "capsule" such as that described by Gibbs[1] is arranged in series with the primary of an ordinary A-C bell-ringing transformer and a 110 V A-C source; the 6-10 volt secondary actuates the recording device. The drop (1 per cent. NaCl solution) closes the electrode gap in the primary circuit. It is displaced from a flask of suitable size by the fluid whose rate of flow is being studied. The fluid system is closed and air excluded from it. There is virtually no evolution of gas at the primary gap because of the alternating character of the current. Considerable dilution of the electrolyte solution is possible before effective conductivity is impaired.

In classroom demonstrations, the kymographic record of the drops is not clearly visible to students at a distance. Therefore in demonstrations we also use an electric light bulb which flashes when contact is made. This is provided by placing a 7½ watt 110 V lamp between the electrode gap and the transformer primary, in parallel with the primary.

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A SIMPLE METHOD FOR QUIETING PARAMECIUM AND OTHER SMALL ORGANISMS DURING PROLONGED OBSERVATION

Paramecium is notoriously difficult to immobilize while alive. This is evidenced by the papers of J. S. Lee[1] and J. B. Buck[2] presenting beautiful though somewhat elaborate methods to bring this animal under control.* Consequently it seems worth while to record a very simple but effective technique adapted from Lieutenant W. G. Downs,[3] who originated the method in connection with preserving Giemsa blood films and quieting mosquito larvae.

A solution of completely hydrolyzed, medium viscosity polyvinyl alcohol is prepared by stirring the powdered alcohol into water until the solution is as thick as heavy molasses—approximately 12 to 14 grams of dry alcohol in 100 cc of water. This should be done over a steam bath and the solution left until all bubbles rise to the surface after which the solution will be glass clear. The solution should then be poured into a wide-mouthed stoppered bottle where it will keep indefinitely. The above holds for "Type B Grade RH-349-N" available at about $1.00 a pound from the E. I. du Pont de Nemours Company, Electrochemicals Department, Niagara Falls, N. Y. Other forms of polyvinyl alcohol, e.g., grade "RH-349-N," can be used but go into solution with much more difficulty and remain cloudy.

In use, two drops of a thick suspension of parameciums, as from a rich boiled lettuce culture,[4] are placed on a slide and two drops of the polyvinyl alcohol solution added. The whole is thoroughly stirred with a needle and covered with a cover glass. The animals are brought almost to a standstill at once and will remain so in good condition for over four hours. Abrupt and striking reversals of ciliary beating and many other details are clearly visible. The frequency of pulsation of the contractile vacuoles usually becomes slower after three hours. The cover glasses are self-sealing because the polyvinyl alcohol dries to form a firm membrane that prevents further evaporation. The slides can be cleaned merely by soaking briefly in water.

Stentor coeruleus presents a handsome object when immobilized by this method. The same holds for the larger hypotrichs and various small aquatic oligochaetes like *Nais* and *Chaetogaster*.

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